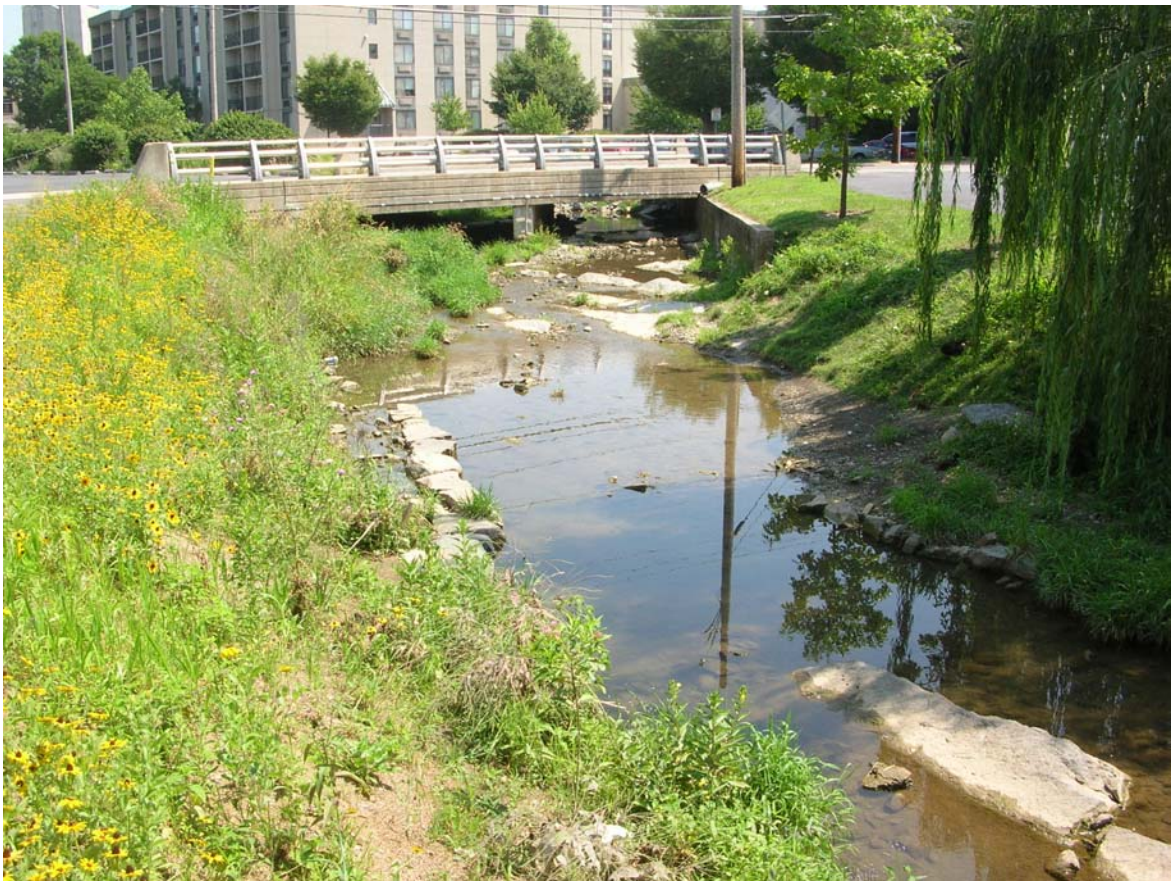
# Water Quality Implementation Plan for Blacks Run and Cooks Creek (Fecal Coliform and Aquatic Life TMDLs)



**Submitted to**
**The Stakeholders of**
**Blacks Run and Cooks Creek**

Prepared by:

Virginia Department of Conservation and Recreation
in cooperation with the Virginia Department of Environmental Quality

**May 25, 2006**

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**Also Available for this project:**
**Total Maximum Daily Load Implementation Plan for Blacks Run and Cooks Creek (Fecal Coliform and Aquatic Life TMDLs) Technical Report***

***MapTech, Inc. developed the Technical Report in cooperation with VADCR**


**Acknowledgements:** Many representatives of various groups and private citizens contributed to the development of this plan. Representatives from the following agencies and groups played a critical role in this project:

- Virginia Dept. of Health
- Harrisonburg Public Works
- Harrisonburg Public Utilities
- Rockingham Community Development
- Natural Resources Conservation Service
- Friends of Blacks Run Greenway
- VDOT
- Virginia Dept. of Environmental Quality
- Harrisonburg Community Development
- Harrisonburg Parks and Recreation
- Shenandoah Valley SWCD
- Rockingham Farm Bureau
- Canaan Valley Institute
- Virginia Cooperative Extension

# 1. Introduction

The Virginia Department of Environmental Quality (VADEQ) monitors waterways throughout the state to determine if waters meet water quality standards and support their designated uses. The United States EPA, through Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations, requires that states develop a Total Maximum Daily Load (TMDL) study for any water body that is found to be impaired, or exceeding a water quality standard. These TMDL studies identify the sources of impairment and reductions needed in those sources in order to bring the water body into compliance with water quality standards. Section 62.1-44.19:7 of Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) requires the development of an implementation plan (IP) following the completion of a TMDL to "achieve fully supporting status for impaired waters". A TMDL Implementation Plan provides a detailed outline of suitable best management practices (BMPs) and a strategy that may be implemented in order to meet water quality standards. These BMP strategies are developed with input from the local community.

*1.1 Fecal Coliform Impairment*

Blacks Run and Cooks Creek were initially placed on Virginia's 303(d) list of impaired waters in 1996 for violations of the fecal coliform (FC) bacteria water quality standard and the General Standard for aquatic life (benthic) (Table 1, Figure 1). TMDLs were completed for both impairments in Blacks Run and Cooks Creek in 2002. The fecal coliform impairment indicates that the streams are not suitable for primary contact recreation (i.e., swimming). A water body is considered impaired if the fecal coliform numeric water quality standard is surpassed more than 10.5% of the time during an assessment period. The fecal coliform TMDLs identified agricultural livestock direct deposition and runoff, untreated human waste disposal, wildlife, and runoff from residential and urban land as significant sources of bacteria in these watersheds. The resulting decreased bacteria loads from each source needed to meet water quality standards are identified as the TMDL allocations.

Fecal coliform and *E. coli* bacteria are used as indicators of the presence of microorganisms that cause illness in humans including Cryptosporidium, Giardia, Shigella and *E. coli O157:H7*. These bacteria are found in the digestive systems of warm-blooded animals. The detrimental effects of bacteria in food and water supplies have been documented in areas throughout the United States and Canada. In May 2000 there were seven confirmed deaths with four other deaths under investigation, and over 2000 poisonings all attributed to drinking water polluted by *E. coli* Type 0157:H7 in the town of Walkerton, Ontario (Raine, 2000; Miller, 2000). The contamination resulted in a $250 million class action lawsuit filed against the Ontario government. The source of the pollution according to the Cattleman's Association was probably runoff from a feedlot located more than 5 miles from the wells used for the town's water supply.

Fecal contamination of surface and drinking waters has also impacted communities in Virginia. The Virginia Department of Health (VDH) was notified of campers and counselors at a Shenandoah Valley summer camp developing serious gastrointestinal

illness in August 1994. *E. coli* 0157:H7 was confirmed as the causative agent. In Franklin County Virginia, a 1997 outbreak of illnesses involving 3 children was attributed to E. *coli* (0157:H7) in Smith Mountain Lake. The children were exposed to the bacteria while swimming in the lake and a two year old almost died as a result of the exposure (Roanoke Times, 1997). In August of 1998, 7 children and 2 adults at a daycare center in rural Floyd County were infected with *E. coli* (0157:H7). Upon investigation, two of the properties' wells tested positive for total coliform (Roanoke Times, 1998). On June 6, 2000 Virginia's second largest water source, Crystal Spring in Roanoke, was shut down by Virginia Department of Health for *E. coli* contamination (Roanoke Times, 2000).

These are not isolated cases. Throughout the U.S., the Center for Disease Control estimates at least 73,000 cases of illnesses and 61 deaths per year caused by *E. coli* 0157:H7 alone (CDC, 1995 and 2001). Other fecal coliform pathogens (e.g. *E. coli* 0111) are responsible for similar illnesses. During 2001 and 2002, the Centers for Disease Control and Prevention received reports of 30 outbreaks (defined as >2 people experiencing illness) of gastroenteritis related to recreational waters, many tied directly to fecal contamination (CDC, 2004). These 30 outbreaks account for more than 1,900 confirmed cases of illness. Whether the source of contamination is human or livestock, the threat of these pathogens appears more prevalent as both populations increase.

*1.2 Aquatic Life Impairment*

The aquatic life impairment indicates that the stream is not able to support a healthy aquatic community. The aquatic life TMDLs identified sediment as the primary stressor in Blacks Run and sediment and phosphorus, which contributes to lowering dissolved oxygen concentrations in the water column, as the primary stressors in Cooks Creek. The TMDL allocations for the aquatic life impairment identify the load reductions in each of these stressors from different land uses necessary to improve these streams so that they can support a diverse and healthy aquatic population.

Table 1: Impaired watershed size, impairment length, violation rate of the 235 cfu/100ml *E. coli* water quality standard and condition of the aquatic community listed in the 2004 VADEQ assessment. Fecal coliform violation rates are based on VADEQ monitoring data, 1991-2000.

| Watershed | Watershed Size (acres) | Impairment Length (mi) | FC Violation Rate (%) | Biological Condition |
|---|---|---|---|---|
| Blacks Run | 12,256 | 10.73 | 84 | Moderate-Severely Impaired |
| Cooks Creek | 28,175* | 13.69 | 77 | Moderate Impaired |

*Acreage includes the contributing Blacks Run watershed

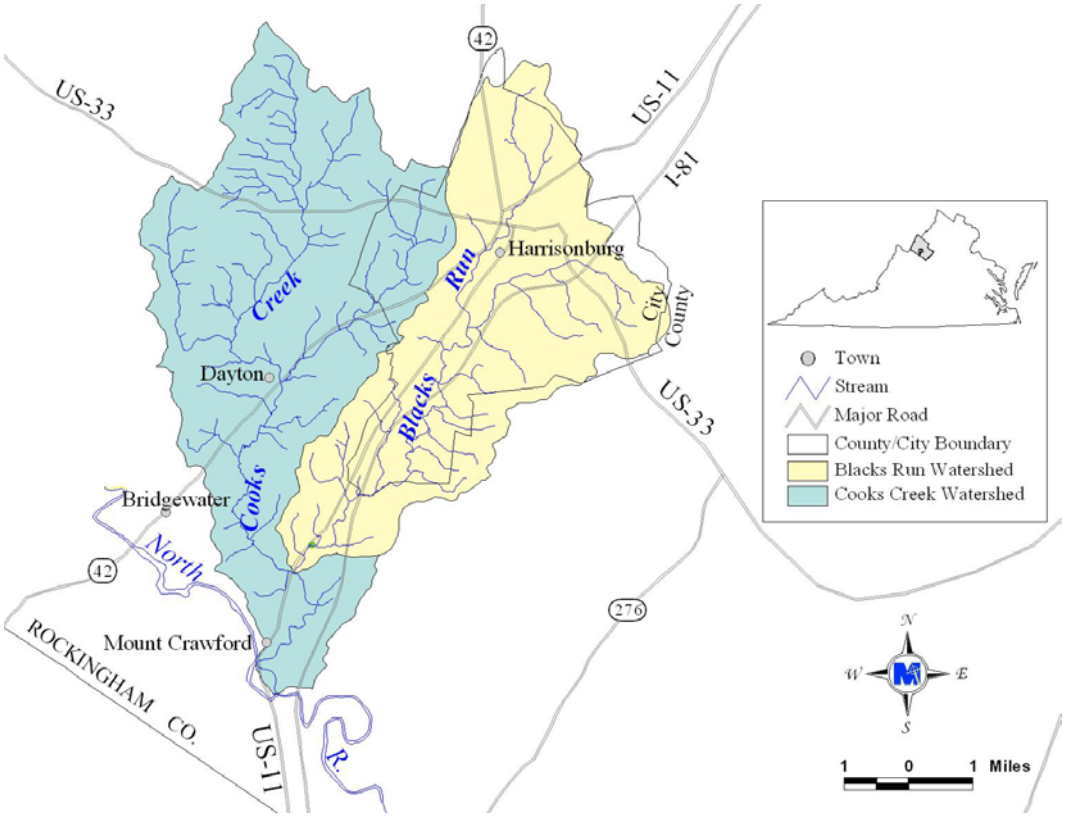

Figure 1: Location of Blacks Run and Cooks Creek watersheds.

A vibrant and healthy aquatic community indicates a healthy stream. Beyond the intrinsic value of having a stream that is full of life, a healthy stream is more attractive than a degraded stream. In an area like Harrisonburg, a healthy waterway downtown has the potential to attract citizens for recreation and shopping. In addition, implementation will enhance recreational resources along Blacks Run, Cooks Creek and their tributaries (i.e., Purcell Park, Westover Park, Cooks Creek Park) for safe use by citizens. The importance of healthy water to local tourism and recreation has become apparent over the past two years during the fish kills on the North and South Fork Shenandoah River. While the exact cause of the fish kills are unknown, these issues highlight the impact of water quality and aquatic health on local communities. In addition, the City of Harrisonburg currently uses the North River as a drinking water source and has plans to use the South Fork of the Shenandoah River as a source in the future.

Successful implementation in these watersheds has implications beyond the local community. Blacks Run and Cooks Creek are in the Chesapeake Bay watershed. Virginia is a partner in the regional effort to reduce nutrient inputs in order to improve the fragile condition of the Bay ecosystem. Success in reducing sediment and nutrient inputs in the Blacks Run and Cooks Creek watersheds will play a small, but vital role in this historic effort.

In fulfilling the state's requirement for the development of a TMDL Implementation Plan, a framework is established for reducing fecal coliform, sediment and phosphorus to levels that meet the water quality goals for which TMDL allocations were developed.

Through the completion of the implementation plan and the establishment of an active implementation project, watershed stakeholders will be on the way to restoring the impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan improves chances for obtaining funding for implementation activities. This document is an abridged version of the *Total Maximum Daily Load Implementation Plan for Blacks Run and Cooks Creek Technical Report*. Both versions are available by contacting the Virginia Department of Conservation and Recreation (VADCR).

## 2. State and Federal Requirements for Implementation Plans

Currently, TMDL implementation plans are not required in the Federal Code; however, Virginia State Code does incorporate the development of implementation plans for impaired streams. There are a number of state and federal requirements and recommendations for TMDL IPs and relevant to their implementation. These requirements and recommendations serve to create a plan that outlines a clear, detailed and achievable solution to water quality impairments. This implementation plan is designed to meet the requirements of Virginia's 1997 Water Quality Monitoring Information and Restoration Act (WQMIRA). It is also designed to meet the recommendations of an approvable IP in EPA's "Guidance for Water Quality-Based Decisions: The TMDL Process" (USEPA, 1999) along with EPA's requirements for Section 319 nonpoint source grants to States. These requirements and recommendations are discussed in greater detail in the technical report.

## 3. Review of TMDL Studies

The Blacks Run and Cooks Creek watersheds are located in Rockingham County and Harrisonburg, Virginia. Water from Blacks Run and Cooks Creek flows into the North River near Mount Crawford, into the South Fork Shenandoah River, and eventually makes its way to the Chesapeake Bay by way of the Potomac River. Blacks Run is impaired for approximately 10.73 miles from its headwaters to the confluence with Cooks Creek. The Blacks Run watershed is approximately 12,256 acres and is comprised of urban/residential (65%), pasture/hay land (18%), cropland (6%) and forest (9%) land uses (Table 2, Figure 2). The Blacks Run watershed is largely urban in northern sections as the stream flows through the City of Harrisonburg and becomes increasingly rural as the stream nears Cooks Creek. Cooks Creek is impaired along a 13.69-mile stretch extending from its headwaters to the confluence with the North River. The Cooks Creek watershed is approximately 15,919 acres, excluding Blacks Run, dominated by cropland (44%), pasture/hay land (23%), urban/residential (25%) and forest (7%) land uses. The Cooks Creek watershed is predominately rural with the exception of the Town of Dayton and areas adjacent to Harrisonburg.

Table 2: Land use distribution in the Blacks Run and Cooks Creek watersheds.

| | Blacks Run | | Cooks Creek* | |
|---|---|---|---|---|
| **Land Use Category** | **Acres** | **% of total** | **Acres** | **% of total** |
| Barren | 144 | 1% | 73 | <1% |
| Cropland | 768 | 6% | 7,075 | 44% |
| Forest | 1,120 | 9% | 1,175 | 7% |
| Hay land | 289 | 2% | 120 | 1% |
| Pasture: Improved | 1,417 | 12% | 3,193 | 20% |
| Pasture: Overgrazed | 11 | <1% | 245 | 2% |
| Pasture: Unimproved | 481 | 4% | 4 | <1% |
| Urban/Residential | 8,002 | 65% | 4,005 | 25% |
| Water | 54 | <1% | 29 | <1% |
| **Total** | **12,256** | **100%** | **15,919** | **100%** |

*Acreage does not include the Blacks Run portion of the Cooks Creek watershed

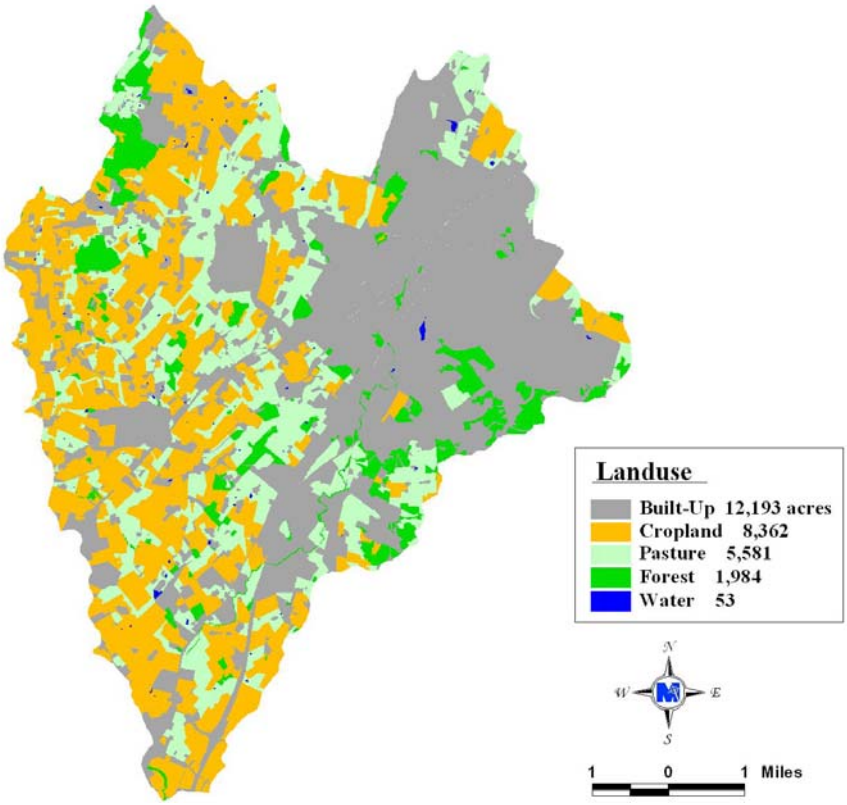


Figure 2: Distribution of land use categories in the Blacks Run and Cooks Creek watersheds.

Water quality monitoring in both streams indicates high violation rates of the 1,000 cfu/100ml fecal coliform standard. The VADEQ data from 1991-2000 referenced in the TMDLs, measured violation rates of 75% and 90% in Blacks Run and Cooks Creek, respectively. Additionally, VADEQ data from the 2004 assessment report to EPA shows violation rates of the current *E. coli* standard of 84% and 77% for Blacks Run and Cooks

Creek, respectively. The United States Geological Survey (USGS) developed the Blacks Run fecal coliform TMDL. Tetra Tech, Inc. developed the fecal coliform TMDL for Cooks Creek. EPA approved both TMDLs in 2002. The studies employed a water quality model (HSPF), land use data, bacteria source information, hydrology, water quality monitoring data and local citizen and agency input to determine the sources of fecal coliform in the watersheds and the reductions necessary to bring the streams into compliance with water quality standards. In the Cooks Creek watershed agricultural and residential/urban sources comprise 93% and 5% of the total bacteria load, respectively. In the Blacks Run watershed agricultural and residential/urban sources comprise 67% and 30% of the total bacteria load, respectively. The TMDLs were developed to result in 0% violations of the fecal coliform water quality standard. Significant reductions are needed from all land uses in order to meet the water quality goals (Table 3, Table 4).

Implicit in the TMDLs is the requirement to keep all other bacteria sources at or below current levels. Currently, EPA guidance allows DEQ to remove a stream segment from the impaired waters list when the violation rate is 10.5% or less in an assessment period. Although not as severe as the load reductions required to achieve 0% violations, the reductions needed to achieve a violation rate below 10.5% in these watersheds are significant. Approaches to achieving these goals are outlined in section 6.

If the fecal bacteria water quality goals are not achieved after addressing residential, urban and agricultural sources, wildlife reductions may be addressed or a process could be initiated (*i.e.,* use attainability analysis) to change the designated use of the streams. The current designated use of the streams is full contact recreation, which includes swimming. Virginia allows the adoption of a secondary contact designated use in the case that the residential, urban and agricultural sources are addressed to the "maximum extent practicable" and water quality goals are still not being met. The secondary contact designation indicates that the water body is not designated for swimming use or other activity that could result in the ingestion of water.

Tetra Tech Inc. developed the aquatic life (benthic) TMDLs for both Blacks Run and Cooks Creek. EPA approved both of these TMDLs in 2002. Excessive sedimentation due to agricultural and urban runoff, streambank destabilization, the loss of riparian buffers, and other processes are considered to be a primary cause of the listed benthic impairments in Blacks Run and Cooks Creek. Agricultural sources of sediment comprise 56% of the sediment load in Blacks Run and 94% of the sediment load in Cooks Creek. The remaining sediment load is from primarily urban sources. In addition, the decreased availability of dissolved oxygen resulting from high phosphorus levels was identified as a primary stressor to the benthic community in Cooks Creek. The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was used to model sediment and phosphorus in both watersheds. Since there was no state standard for sediment or phosphorus at the time of the TMDLs, a reference watershed approach was used to establish the water quality goal or endpoint for TMDL allocations. The sediment and phosphorus reductions by land use and source for Blacks Run and Cooks Creek are presented in Tables 5 and 6, respectively.

Table 3: Percent load reductions by land use required for the Blacks Run fecal coliform TMDL.

| Impairment | Impervious Land Surface (NPS) | | Pervious Land Surface (NPS) | | | | | | | Direct Loads (PS) | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urban | Residential | Urban | Residential | Pasture | Hay land | Cropland | Forest | Barren | Cattle in-stream | Human[1] |
| Blacks Run | 98% | 98% | 94% | 98% | 94% | 95% | 93% | 90% | 94% | 99% | 100% |

[1] Includes failing septic systems, overflows, leaking sewer lines and illicit connections

Table 4: Percent load reductions by land use required for the Cooks Creek fecal coliform TMDL.

| Impairment | Cropland | Pasture | Forest* | Built-Up | Interflow & Groundwater | Cattle Direct Deposits | Wildlife Direct Deposits | Failing Septic Systems | Straight Pipes |
|---|---|---|---|---|---|---|---|---|---|
| Cooks Creek | 99% | 99% | 0% | 99% | 99% | 100% | 97% | 100% | 100% |

*In the Cooks Creek TMDL forest land was treated as a background condition and therefore was not considered an option for load reductions

Table 5: Percent sediment reductions for the Blacks Run aquatic life TMDL.

| | Cropland | Pasture/Hay | Barren | Forest | Urban | Point Sources |
|---|---|---|---|---|---|---|
| Sediment Reduction (%) | 38% | 37% | 70% | 0% | 29% | 0% |

Table 6: Percent sediment and phosphorus reductions for the Cooks Creek aquatic life TMDL.

| | Cropland | Pasture/Hay | Barren | Forest | Urban | Point Sources | Septic Systems |
|---|---|---|---|---|---|---|---|
| Sediment Reduction (%) | 79% | 70% | 90% | 0% | 51% | 0% | 0% |
| Phosphorus Reduction (%) | 88% | 80% | 90% | 0% | 70% | 0% | 40% |

# 4. Public Participation

The actions and commitments described in this document are drawn together through input from citizens of the watersheds, Rockingham County government, City of Harrisonburg government, VADCR, VADEQ, VDH, VDOT, Virginia Cooperative Extension (VCE), Natural Resources Conservation Service (NRCS), Shenandoah Valley Soil and Water Conservation District (SVSWCD), Friends of Blacks Run Greenway (FBRG), Rockingham County Farm Bureau, the Canaan Valley Institute and others. Every citizen and interested party in these watersheds is encouraged to become involved in implementation of this plan and contribute what they are able to help restore the health of these streams.

Public participation in the IP development took place on three levels. First, a public meeting was held on November 23rd, 2004 to inform local stakeholders about the end goals of the project and solicit participation in smaller, more targeted working group meetings. Second, four working groups were formed from communities of people with common interests and concerns regarding the implementation process. The agricultural, residential, urban and government working groups provide an arena for direct citizen and local agency input in the development of the IP. Each group met at least two times between January and October 2005. Over 270 man-hours were devoted to participating in the working groups. The third opportunity for public input was through the steering committee formed with representation from each working group, watershed citizens, agency representatives and local government representatives. The steering committee met in January 2006 with 19 members present. The purpose of the steering committee is to assimilate the recommendations of the working groups into the IP and guide the overall development of the final IP document. The final public meeting to present the draft implementation plan took place on March 2nd, 2006 and was attended by 21 citizens and agency representatives.

Each working group discussed the type, location and cost of BMPs needed to meet the water quality goals set forth in the TMDLs and how to promote those practices. The following sections summarize the findings and recommendations of each working group. The full reports from each working group are available in the technical report available from VADCR.

*4.1 Agricultural Working Group*

The agricultural working group consists of beef and dairy producers throughout the watershed along with agency and agricultural organization representatives (16 members). The primary tasks of the agricultural working group are to address bacteria, sediment and nutrient sources attributed to agricultural operations, identify any obstacles to implementation of agricultural BMPs and recommend practical solutions to those obstacles. The group discussed the type of livestock exclusion BMPs that would be both effective and practical in these watersheds. Agricultural implementation in these watersheds needs to address the fact that while cost-share is an incentive for some farmers, because of the large Mennonite community a significant number of farmers in these watersheds will not accept cost-share assistance. However, the group agreed that the potential exists for the successful installation of livestock exclusion fence using both

cost-share and voluntary installation, citing the success in the North River TMDL implementation project. The group suggests that the success and benefits of the voluntary exclusion practices that have been installed in the North River project area be used to promote fencing in these watersheds. The group also stressed the importance of establishing a stream buffer in conjunction with the voluntary practices because of the large reductions in land-based loads of bacteria, sediment and phosphorus required by the TMDLs.

The agricultural working group also discussed the cost-share and voluntary BMPs available to reduce land-based (runoff) sources of bacteria, sediment and nutrients and to control animal waste. The group recommends the following sediment, nutrient and animal waste BMPs as being most practical to promote and likely to succeed in these watersheds: small grain cover crop, legume cover crop, animal waste control facility, and sidedress application of nitrogen. The group felt that practices requiring permanent vegetation or reforestation on cropland or pastureland were not likely to be popular in the watershed because of the relatively small size and intensity of farming operations. The group also felt that farmers in the area were unlikely to widely accept nutrient management plans in the future because of the 2006 change to phosphorus based plans.

*4.2 Residential Working Group*

The primary tasks of the residential working group are to (1) find ways to identify and eliminate straight pipes (pipes directly discharging wastewater into a water body without adequate treatment) and failing septic systems, (2) address difficulties faced by landowners in correcting these problems, (3) evaluate technical assistance/staffing needed to administer the residential program and (4) recommend educational and outreach tools that will help promote the implementation of residential BMPs. The group consists of 19 citizens and agency representatives. The group recommends that implementation efforts include a septic tank pump out program in order to identify failing systems and promote septic system maintenance. The group also recommends offering the replacement and repair of malfunctioning septic systems as part of the implementation program. The pump-out program and efforts to address failing septic systems will also focus on homes within 300 feet of the stream in order to identify problems that have the highest potential to impact water quality. However, the group recommends that each case outside of 300 feet of a stream be considered individually because failing systems in a karst area have the potential to deliver bacteria to groundwater supplies. The group anticipates that because of the karst topography and soil conditions, approximately half of all new systems will need to be alternative waste treatment systems.

Education and outreach is the recommended approach to identify straight pipes and failing septic systems. The group discussed the fact that many homeowners with straight pipes may not be aware that they do not have a properly functioning system and that educational activities may motivate landowners to address problems. The residential working group recommends these specific education and outreach tools: (a) targeted informational postcards/mailings, (b) program material provided to septic contractors to distribute to customers, (c) stories in local media outlets focusing on financial assistance, BMPs, and Chesapeake Bay goals, (d) forming a citizens committee to spread word of

the program to the community, and (e) establishing a well testing program to show the implications of properly maintaining waste treatment systems. The group also provided VADCR feedback on the quantity and cost of residential BMPs required to meet water quality goals.

*4.3 Urban Working Group*

The primary tasks of the urban working group are to (1) identify activities and improvements already underway pertaining to urban sources of bacteria, sediment and phosphorus and possibilities that exist for collaboration, (2) identify BMPs to address the subject pollutants that are most practical in local urban areas, (3) evaluate technical assistance/staffing needed to promote, implement and maintain these BMPs and (4) recommend educational and outreach tools that will help promote the implementation of urban BMPs. The group consists of 26 members including watershed citizens, and agency, municipality and community group representatives. Based on scenarios of types, quantities, and costs of BMPs needed to address water quality goals in urbanized settings, the following BMPs are generally recommended by the urban working group; bioretention filters/raingardens, vegetated buffers, streambank stabilization/restoration, urban nutrient management plans, street sweeping, pet litter control programs, and water quality inlets. Specific recommendations pertaining to each of these practices are included in the technical document available from VADCR.

The urban working group recommends these specific outreach and educational tools, focusing on urban implementation and urban issues:

- An erosion and sediment control workshop, focusing on educating the public and key stakeholders in each watershed on E&S law and regulations.
- Demonstration projects in urban areas; the group discussed a series of rain barrel demonstrations downtown as potentially effective.
- A low impact development (LID) information packet, to be distributed to local developers, land design engineers and construction companies.
- A stream assessment, to be completed by school classes in order to obtain data and educate students. The RIVERS assessment was suggested as an option.
- A brochure/mailing, explaining specific practices individuals and small groups should use to reduce pollution from reaching these streams.

*4.4 Government Working Group*

The primary goals of the government working group are to (1) identify technical and financial resources presently available that could support implementation (2) identify regulatory controls that relate to the IP's water quality goals and (3) recommend the most effective delivery of implementation. The group consists of 25 representatives from a variety of local, state and federal agencies. The group discussed and recommended the roles of some of the stakeholder agencies and organizations in the implementation project. The Shenandoah Valley Soil and Water Conservation District (SVSWCD) will administer the agricultural and residential implementation programs. In residential implementation, the VDH will write permits for new systems and refer customers needing assistance to SVSWCD. The NRCS will provide BMP design support to SVSWCD along with providing financial and technical services to farmers through

existing programs such as the Conservation Reserve Enhancement Program (CREP) and the Environmental Quality Incentives Program (EQIP). Urban implementation will require the coordination between multiple agencies and stakeholder groups including VADCR, City of Harrisonburg, Rockingham County, VDOT and FBGR. Currently the City, FBRG and Canaan Valley Institute are collaborating on a project that is aiming to restore 3,000 feet of Blacks Run and Seiberts Creek in Purcell Park. VADEQ will maintain the water quality monitoring schedule as described in this document. FBRG, Friends of the Shenandoah River and the City of Harrisonburg will provide additional water quality data through their existing monitoring programs.

Regulatory controls identified by the government working group as relating to implementation include Virginia Sewage Handling and Disposal Regulations, the Virginia Agricultural Stewardship Act, Virginia Erosion and Sediment Control Law and Regulations, Virginia Nutrient Management Law and Regulations, City of Harrisonburg pet waste and illicit discharge ordinances, and Virginia Pollution Discharge Elimination System (VPDES) permits. Currently the City of Harrisonburg and VDOT hold Phase II VPDES stormwater permits and JMU is in the process of obtaining a permit. The group discussed the relationship between the VPDES permits and this implementation plan. The permit requires the owners of a small municipal separate storm sewer system (MS4) to address pollutant loads in stormwater through 6 programmatic BMPs. City staff recommends that the VPDES guidance clarify the distinction between the BMPs included in the VPDES permit, which deals primarily with new construction, and retrofits required on existing facilities needed to meet goals set by the implementation plan. The group expressed concern about costs required to maintain the type of E&S program and provide staffing for additional stormwater BMPs that are suggested in the implementation plan.

## 5. Assessment of Implementation Action Needs

This section outlines the selection and quantification of appropriate BMPs necessary to reduce pollutants and meet water quality standards. An implementation strategy and milestones for meeting water quality goals are presented in the following section.

### *5.1 Selection of Appropriate BMPs*

Potential control measures, their associated costs and pollutant removal efficiencies, and potential funding sources were identified through review of the TMDL, input from working groups, and literature review. Control measures were assessed based on cost, reasonable assurance of implementation, and water quality impacts. The allocations determined during the TMDL development dictate some of the control measures that must be employed during implementation. In order to meet the 99-100% reductions in direct deposition from livestock, some form of stream exclusion is necessary. Due to the nature of the farming community in these watersheds, both cost-share and voluntary livestock exclusion practices are identified as appropriate for implementation. While it is recommended that all fencing, even that which is installed solely at the landowner's expense, be placed at least 35 ft from the stream (as is required for cost-share practices), it was pointed out during working group discussions that approximately 75% of the affected population in these watersheds is likely to install streamside fencing without cost-share and that these producers were more likely to establish a smaller buffer area.

For planning purposes, an average buffer width of 15 ft was assumed in these instances, and costs were based on the use of polywire fencing.

The 100% reduction in loads from straight pipes, failing septic systems, sewer leaks, and sewer overflows is a pre-existing legal requirement as well as a requirement of the TMDLs. This reduction indicates that all illicit discharges (*i.e.*, straight pipes and cross-connections) in the watersheds should be corrected, and that all onsite sewage treatment systems (*e.g.,* septic systems and alternative waste treatment systems) and sewer infrastructure must be maintained in proper working condition. Correction of sewer overflows and leaks is an ongoing effort of the entities charged with the maintenance and operation of these systems and local efforts are described in further detail in section 7.5 of this document. The options identified for correcting illicit discharges and failing septic systems include: sewer line connection, installation of a septic system, repair of an existing septic system, and installation of an alternative waste treatment system. Connection to a sewer line was viewed as the most permanent solution to the problem, but this solution is only economically feasible if the sewer line is close enough to make the cost competitive with installing a septic or alternative waste treatment system. It is also anticipated that a significant portion of straight pipes will be located in areas where an alternative waste treatment system will be required.

In addition to the control measures that are directly indicated by the TMDL, a number of measures are needed to control fecal bacteria, sediment, and phosphorus from land-based sources. Various scenarios were developed and presented to the working groups. All scenarios began with implementation of the measures indicated by the TMDL. Next, specific sources of fecal bacteria were addressed where highly economic practices were identified. For instance, a pet-litter-control education program was specified in each watershed. Additionally, storage and composting of poultry litter was addressed in each watershed through inclusion of waste storage facilities. Similarly, with regard to sediment and phosphorus, cost-effective practices that specifically address these pollutants were identified. Additional control measures include street sweeping, erosion and sediment (E&S) controls on construction sites, streambank restoration, waste storage facilities, improved pasture management, conservation tillage, vegetated buffers, and nutrient management in the agricultural, residential, and urban settings.

Beyond this level of control for the pollutants of interest, practices that require the control or treatment of runoff are the primary tools available. These measures control bacteria, sediment, and phosphorus. The resulting set of additional BMPs include; bioretention filters, rain gardens, and retention ponds. A description of each of the identified BMPs along with target locations is included in Appendix A.

*5.2 Quantification of BMPs*

A summary of methods used to quantify BMPs is provided in this section. The final set of BMPs identified and the efficiencies used in this study to estimate implementation needs are listed in Table 7. A more comprehensive explanation of these methods is included in the technical report.

Table 7: Control measures identified as appropriate for implementation and the associated pollution reduction efficiencies.

| Control Measure | Efficiencies | | | Reference |
|---|---|---|---|---|
| | **Bacteria** | **Sediment** | **Phosphorus** | |
| *Direct Reduction Efficiency* | | | | |
| Streamside Fencing | 100% | 0% | 0% | 1 |
| Corrected Straight-Pipe | 100% | 100% | 100% | 2, 7 |
| Repaired Septic System | 100% | 100% | 100% | 2, 7 |
| Pet Litter Control Program | 75% | 0% | 0% | 3 |
| Manure Storage | 75% | 75% | N/A | 2, 7 |
| Poultry Litter Storage | 99% | 0% | 0% | 4 |
| Street Sweeping (Regenerative Air Sweeper) | 550,000,000 colonies/yr | 288 tons/yr | 361 lbs/yr | 4, 6, 8 |
| Streambank Restoration | N/A | 2.55 lbs/ft/yr | 0.0035 lbs/ft/yr | 2 |
| Nutrient Management | 0% | 0% | 22% | 2 |
| *Buffer Efficiency*[a] | | | | |
| Vegetated Buffer | 50% | 50% | 50% | 2 |
| *Runoff Treatment Efficiency* | | | | |
| Improved Pasture Management | 50% | 50% | 50% | 2 |
| Conservation Tillage | 61% | 61% | 52% | 5, 7, 9 |
| E&S Controls | 85% | 85% | 72% | 2, 7, 9 |
| Rain Gardens | 85% | 85% | 60% | 2, 7 |
| Bioretention Filters | 85% | 85% | 60% | 2, 7 |
| Retention Ponds | 80% | 80% | 50% | 2, 7 |

a Buffer efficiencies shown here are applied to runoff from twice the buffer area upstream of the buffer. Additional reductions result from the conversion of land from its existing condition to the buffer area.

1 Removal efficiency is defined by the practice.

2 Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/

3 Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

4 Local Measurements.

5 Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1992. Soil and Water Conservation Engineering, 4th Edition. Wiley.

6 Curtis, M.C. 2002. Street sweeping for pollutant removal. Department of Environmental Protection. Montgomery County, MD. 17pp.

7 Bacteria efficiency estimated based on sediment efficiency.

**8** Annual measurements of total solids collected in the City of Harrisonburg combined with efficiencies reported for regenerative air sweepers to estimate phosphorus and bacteria efficiencies.

**9** Phosphorus reductions based on sediment-associated phosphorus modeled in the watershed.

*Agricultural BMPs*: Livestock exclusion fencing requirements were estimated by overlaying the stream network with land use. Perennial and intermittent stream segments that flow through or adjacent to land-use areas that have a potential for supporting cattle (*e.g.,* improved pasture) were identified. If the stream segment flows through the land-use area, it is assumed that fencing is required on both sides of the stream, while if a stream segment flowed adjacent to the land-use area, it is assumed that fencing is required on only one side of the stream. These assumptions were further refined to examine changes in land use since TMDL development, taxable land use criteria, size of resultant pasture, zoning, and existing BMPs. Existing exclusion fencing identified in the DCR Agricultural BMP database and through a survey conducted by the SVSWCD is accounted for in implementation estimates. The length of fencing required to fence livestock out of streams in the study area is approximately 14 miles (Figure 3).

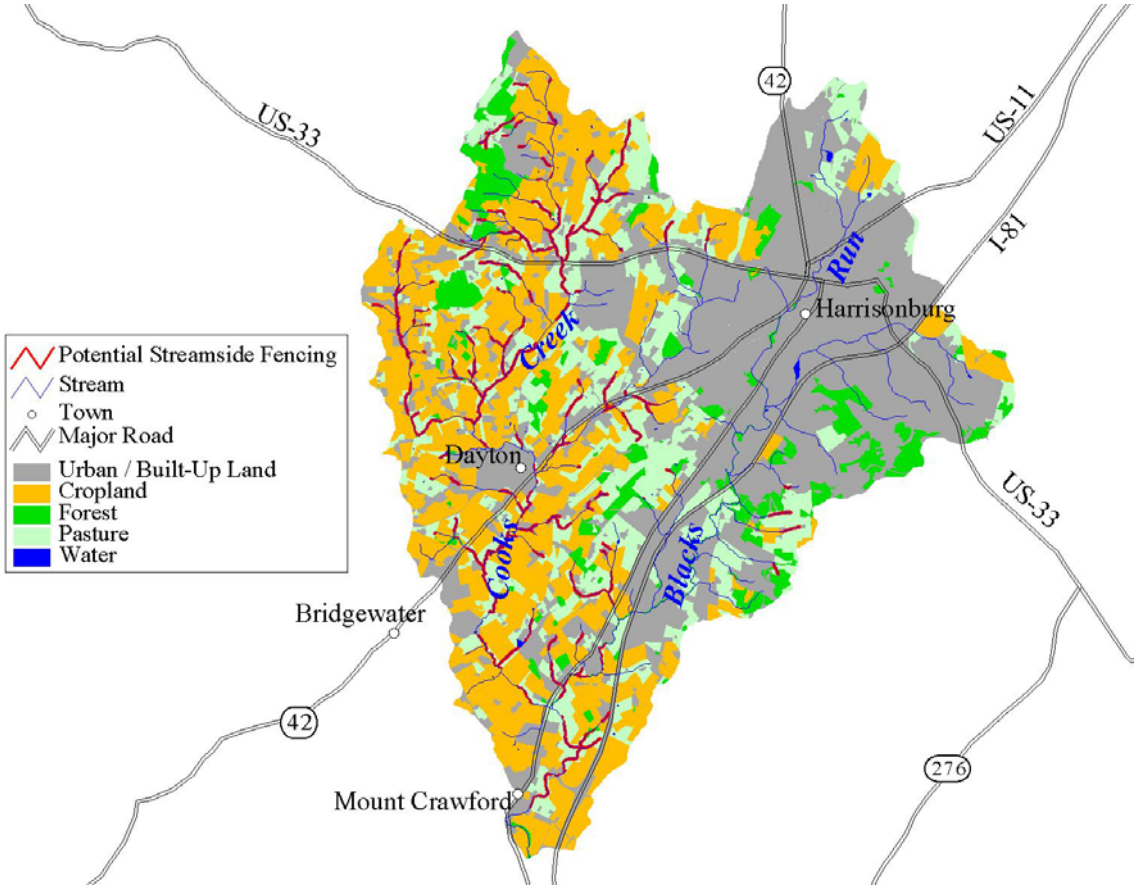


Figure 3: Potential streamside fencing for perennial and intermittent streams in the Blacks Run and Cooks Creek watersheds.

The VADCR Agricultural BMP Database was utilized to determine typical characteristics (*e.g.,* streamside fencing length per practice) of full livestock exclusion systems leading to the quantification of the number of required systems. The database was queried for

information on Grazing Land Protection Systems (SL-6) and Stream Protection Systems (WP-2 and WP-2T) installed in Rockingham County. The SL-6 system includes streamside fencing, cross fencing, alternative watering system, and a 35-ft buffer from the stream. The WP-2T system includes streamside fencing, hardened crossings, and a 35-ft buffer from the stream. In cases where a watering system already exists, a WP-2T system is a more appropriate choice. To establish the total number of full livestock exclusion systems necessary to achieve full implementation, systems were calculated by dividing the potential pasture streamside fencing required by the average streamside fencing length per system. Existing cost-share practices and voluntary exclusion fencing surveyed by the SVSWCD were taken into account in these estimates. It is estimated that 8 new livestock exclusion systems (SL-6 and WP-2) through cost-share are required. Based on the number of Mennonite farmers in the watersheds and input from SVSWCD, it is assumed that the remaining livestock exclusion (approximately 10 miles) will need to be achieved through voluntary practices.

The Cooks Creek and Blacks Run TMDLs require large reductions to land-based agricultural loads. In order to meet these strict requirements, waste storage, improved pasture management, conservation tillage, retention ponds, bioretention filters, vegetated buffers and nutrient management were quantified using the water quality modeling software described in section 3 and the efficiencies listed in Table 7. Existing practices were surveyed or estimated by the SVSWCD. In the quantification of agricultural BMPs land use changes in the watersheds since the TMDL development in 2001 were taken into account. These changes include the conversion of pastureland to cropland in Cooks Creek and the planned development of agricultural land in the lower Blacks Run watershed.

*Residential BMPs*: All straight pipes and failing septic systems must be identified and corrected during implementation since a 100% load reduction from these sources was deemed necessary to meet the TMDL goal. The number and location of failing septic systems and straight pipes is based on analysis of census data and review by the residential working group (RWG). The percentage of homes on a septic system in each subwatershed is determined from data from the 1990 and 2000 census. The number of failing septic systems is determined using septic system failure rates (13.5%) presented in the TMDL document. The number of straight pipes is determined by applying a straight pipe density to all households that reported a waste treatment system of "other" on their 1990 census in a 200 ft buffer of perennial streams. The number of systems is adjusted using information from the 2000 census. The RWG estimated that approximately half of the failing septic systems would need basic repairs, while the remainder would need new systems. It is assumed that half of the installed systems would be standard septic systems and the other half would be alternative systems. The implementation estimates assume that all failing systems within 300 feet of a stream will be addressed. In addition to the repair and installation of treatment systems, a septic tank pump-out program addressing 100 systems within 300 ft of streams is planned to identify problems and educate citizens on septic system maintenance.

Sewer service is available in the City of Harrisonburg and Town of Dayton. Based on spatial analyses and input from local utilities, the potential for sewer hook-up was determined. The numbers of non-sewered homes that are close enough to existing sewer lines to make a sewer connection economically feasible are 189 and 74 in Harrisonburg and Dayton, respectively. Based on this analysis and the percentage of homes estimated to have failing systems, it was determined that the number of homes requiring a new system that are likely to benefit from a sewer hook-up were 2 and 1 in Blacks Run and Cooks Creek, respectively. In addition to these residential control measures, it is recognized that educational efforts discussed in this section and section 4 of this report will be vital to the successful implementation of these TMDLs.

*Urban BMPs*: With the exception of streambank stabilization/restoration, the majority of urban BMPs identified in this study primarily serve to treat land-based sources of bacteria, sediment, and phosphorus. The BMPs needed for two stages of implementation were quantified using accepted treatment efficiencies identified in Table 7 and water quality modeling methods described in Section 3 and the technical document. Estimates of streambank stabilization needs are based on modeling results along with input from local citizens and agency personnel. Existing bioretention filter practices were identified through a survey with the help of City of Harrisonburg personnel. The current level of street sweeping, as reported in Harrisonburg's MS4 permit, was also accounted for in implementation estimates.

Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop over time, as implementation proceeds. One potential for additional sources of the pollutants identified is future urban and residential development. The principles of low-impact development (LID) should be considered, whenever feasible, as increased pollutant loads from newly developed sources could undermine the work being proposed in this IP.

# 6. Measurable Goals and Milestones

*6.1 Implementation Goals*

State and EPA guidance requires IPs to identify the BMPs necessary to meet the TMDL allocations. EPA guidance also requires that there is a "reasonable assurance" that implementation will be completed. The requirement of "reasonable assurance" implies that a staged scenario be developed in the case that full implementation requirements are not practical or reasonable in current conditions; consequently, implementation has been divided into two stages (Table 8, Table 9). Through evaluation of implementation scenarios and working group input, Stage I implementation was identified as a reasonable level of implementation when taking into account costs and land availability. Stage I focuses on cost-effective, targeted practices such as livestock exclusion, improving pasture management, storage of manure prior to land application, correcting straight pipes and failing septic systems, implementing a pet waste control program, installing vegetated buffers and street sweeping. These efforts, combined with a limited amount of bioretention filters, retention ponds and rain gardens will provide significant progress towards bacteria, sediment and phosphorus reduction goals (Table 8, Table 9) at

reasonable cost. Stage I is designed to achieve much of the needed reductions without overly intensive actions. Stage II implementation entails installing the additional BMPs that are required to meet the remainder of the water quality goals outlined in the TMDLs. Stage II focuses more heavily on the stormwater treatment practices that are generally more expensive and require significant land area.

Tables 8 and 9 include the anticipated water quality response following each stage of implementation. Water quality response is estimated using the modeling methods described above. The bacteria response shown is the anticipated rates of violation of the 1,000 cfu/100ml and 400 cfu/100ml bacteria water quality standards following the installation of BMPs associated with each implementation stage. The violation rate of the 400 cfu/100ml is shown in parenthesis. These rates illustrate that although the streams will still be considered impaired following the installation of Stage I BMPs (>10.5% violation rate), the violations of the water quality standards decrease significantly from current conditions. The progress towards phosphorus and sediment goals is shown as the percentages of the total reduction in the amount of these pollutants that is called for in the TMDL studies.

*6.2 Implementation Milestones*

This staged implementation approach is based on meeting water quality goals over a fifteen-year period. Stage I implementation is scheduled to begin in May 2006 and be completed over a five-year period by 2011. It is anticipated that implementation will roughly follow an even schedule with about 20% of Stage I BMPs installed each year with individual milestones at 2, 4, and 5 years after implementation begins (Figure 4, Figure 5). Following Stage I, the steering committee should evaluate water quality improvements and determine how best to proceed to complete implementation. The timeline presented here proposes completing Stage II after ten years from the start of implementation with individual milestones at 7, 9, and 10 years. Figures 4 and 5 illustrate that significant pollutant reductions can be achieved in Stage I with reasonable costs. Implementation costs are addressed further in section 6.5. Based on completing both implementation stages, the final milestone will be de-listing of the impaired segments from the Section 303(d) list by 2021.

Progress toward water quality goals will be assessed during implementation through the tracking of BMP installations by VADCR and continued water quality monitoring by VADEQ, FBRG and Friends of the Shenandoah River. A detailed explanation of the planned monitoring network is included in section 6.4. VADCR and the steering committee will evaluate progress and monitoring data periodically with a comprehensive evaluation at the end of the proposed five-year Stage I implementation period. The five-year evaluation should take place in 2011 and include a review of the effectiveness of the Stage I approach. Based on this review, the steering committee should decide on a course of action for further implementation. Options will include continuing on to Stage II as designed, amending the Stage II goals and milestones, or pursuing alternatives such as a use attainability analysis (UAA) in order to change the designated use of the stream from primary contact (swimming) to secondary contact. This would basically establish that the stream is not suitable, or used, for swimming and similar activities.

Table 8: Stage I and Stage II implementation goals for Cooks Creek.

| | | Cooks Creek | | |
|---|---|---|---|---|
| **Control Measure** | **Units** | **BMPs surveyed since 2001** | **Stage I** | **Stage II** |
| ***Agricultural*** | | | | |
| Grazing Land Protection Systems (SL-6) | Systems | 4 | 6 | 0 |
| Stream Protection Systems (WP-2T) | Systems | N/A | 1 | 0 |
| Voluntary Exclusion Systems | Feet | 9,000 | 44,679 | 0 |
| Fence Maintenance | Feet | N/A | 2,013 | 2,013 |
| Waste Storage – Poultry | Systems | 27 | 31 | 0 |
| Waste Storage – Livestock | Systems | 40 | 12 | 0 |
| Improved Pasture Management | Acres | 293 | 567 | 0 |
| Conservation Tillage | Acres | N/A | 4,413 | 0 |
| Retention Ponds | Ac-treated | N/A | 0 | 4,475 |
| Bioretention Filters | Ac-treated | N/A | 0 | 4,595 |
| Vegetated Buffer | Acres | 10 | 0 | 158 |
| Nutrient Management | Acres | 2,735 | 3,565 | 0 |
| ***Residential*** | | | | |
| Septic System Repair | System | N/A | 19 | 0 |
| Septic System Installation | System | N/A | 11 | 0 |
| Alternative Waste Treatment System Installation | System | N/A | 11 | 0 |
| Sewer Connection | System | N/A | 1 | 0 |
| Septic Tank Pump-Outs | System | N/A | 76 | 0 |
| Pet Litter Control Program | Program | N/A | 1 | 0 |
| Rain Gardens | Ac-treated | N/A | 600 | 900 |
| Street Sweeping | Lane-miles/yr | N/A | 1,515 | 0 |
| Streambank Stabilization | Feet of stream | N/A | 1,000 | 1,000 |
| Vegetated Buffer | Feet of stream | N/A | 42,290 | 0 |
| ***Urban*** | | | | |
| E&S Controls | Acres | N/A | 73 | 0 |
| Pet Litter Control Program | Program | N/A | 1 | 0 |
| Bioretetion Filters | Ac-treated | N/A | 400 | 270 |
| Retention Ponds | Ac-treated | N/A | 400 | 270 |
| Street Sweeping | Lane-miles/yr | N/A | 2,272 | 0 |
| Streambank Stabilization | Feet of stream | N/A | 1,000 | 1,000 |
| Vegetated Stream Buffer | Feet of stream | N/A | 40,424 | 0 |
| Nutrient Management | Acres | N/A | 1,100 | 0 |
| ***Pollutant Reductions*** | | | | |
| Bacteria (% violations) | | | 19% (41%) | 9% (29%)* |
| Sediment (% of reduction goal) | | | 68% | 100% |
| Phosphorus (% of reduction goal) | | | 77% | 100% |

*Lowest violation % obtainable without addressing existing wildlife loads

Table 9: Stage I and Stage II implementation goals for Blacks Run.

| | | Blacks Run | | |
|---|---|---|---|---|
| **Control Measure** | **BMPs surveyed since 2001** | **Existing BMPs** | **Stage I** | **Stage II** |
| ***Agricultural*** | | | | |
| Grazing Land Protection Systems (SL-6) | Systems | N/A | 1 | 0 |
| Stream Protection Systems (WP-2T) | Systems | N/A | 0 | 0 |
| Voluntary Exclusion Systems | Feet | N/A | 127 | 0 |
| Fence Maintenance | Feet | N/A | 55 | 55 |
| Waste Storage – Poultry | Systems | N/A | 3 | 0 |
| Waste Storage – Livestock | Systems | N/A | 0 | 0 |
| Improved Pasture Management | Acres | N/A | 191 | 0 |
| Conservation Tillage | Acres | N/A | 335 | 0 |
| Retention Ponds | Ac-treated | N/A | 0 | 503 |
| Bioretention Filters | Ac-treated | N/A | 0 | 503 |
| Vegetated Buffer | Acres | N/A | 0 | 0 |
| Nutrient Management | Acres | N/A | 0 | 0 |
| ***Residential*** | | | | |
| Septic System Repair | System | N/A | 5 | 0 |
| Septic System Installation | System | N/A | 3 | 0 |
| Alternative Waste Treatment System Installation | System | N/A | 3 | 0 |
| Sewer Connection | System | N/A | 2 | 0 |
| Septic Tank Pump-Outs | System | N/A | 24 | 0 |
| Pet Litter Control Program | Program | N/A | 1 | 0 |
| Rain Gardens | Ac-treated | N/A | 0 | 25 |
| Street Sweeping | Lane-miles/yr | N/A | 360 | 0 |
| Streambank Stabilization | Feet of stream | N/A | 1,000 | 7,078 |
| Vegetated Buffer | Feet of stream | N/A | 16,156 | 0 |
| ***Urban*** | | | | |
| E&S Controls | Acres | N/A | 144 | 0 |
| Pet Litter Control Program | Program | N/A | 1 | 0 |
| Bioretetion Filters | Ac-treated | 125 | 625 | 1,440 |
| Retention Ponds | Ac-treated | N/A | 0 | 2,190 |
| Street Sweeping | Lane-miles/yr | 3,427 | 3,427 | 0 |
| Streambank Stabilization | Feet of stream | N/A | 4,000 | 45,102 |
| Vegetated Stream Buffer | Feet of stream | N/A | 98,204 | 0 |
| Nutrient Management | Acres | 1,000 | 0 | 0 |
| ***Pollutant Reductions*** | | | | |
| Bacteria (% violations) | | | 18% (25%) | 12% (18%)* |
| Sediment (% of reduction goal) | | | 100% | 100% |
| Phosphorus (% of reduction goal) | | | -- | -- |

*Lowest violation % obtainable without addressing existing wildlife loads

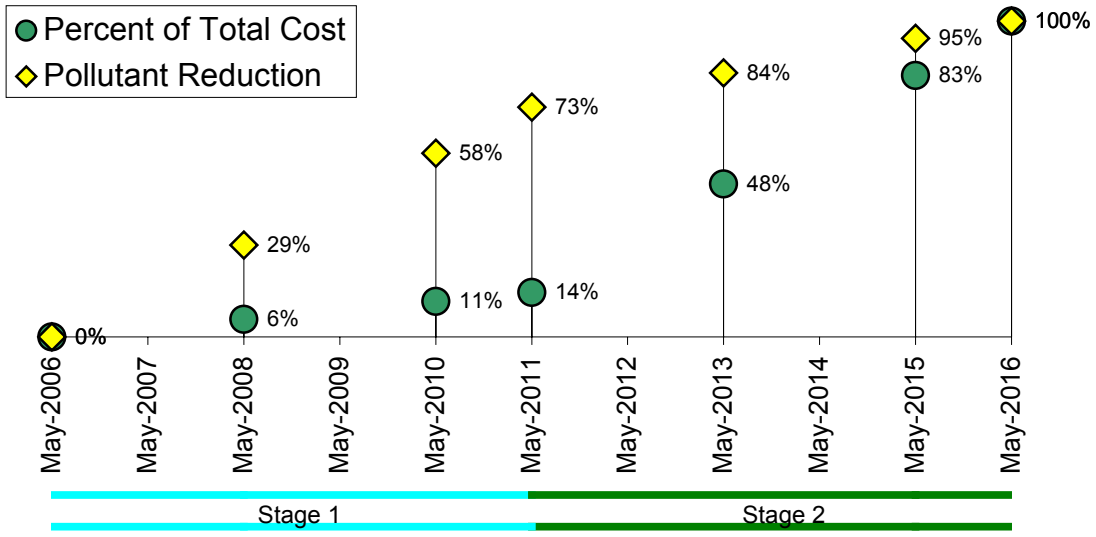


Figure 4: Implementation timeline and milestones for Cooks Creek.

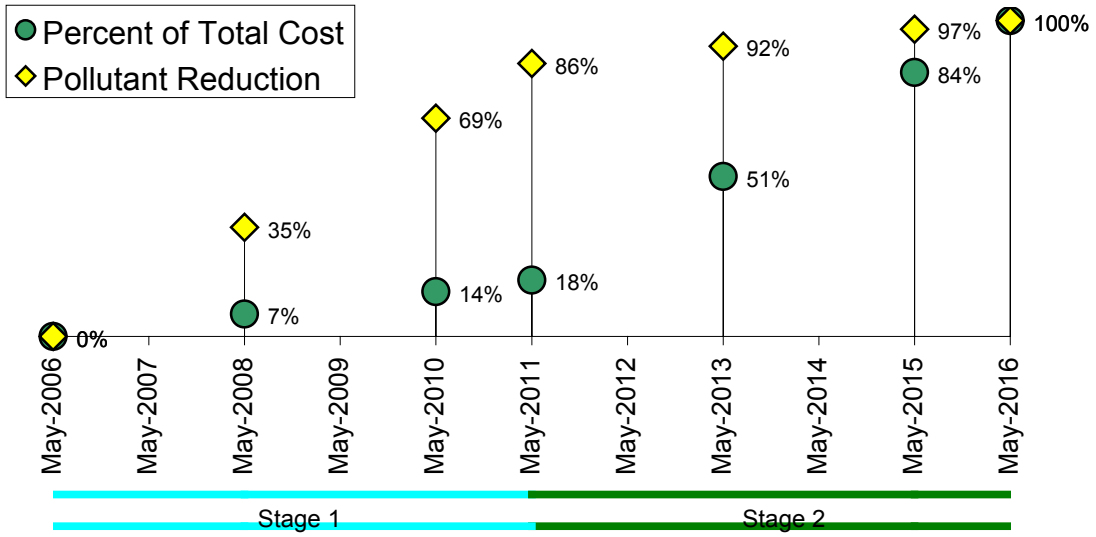


Figure 5: Implementation timeline and milestones for Blacks Run.

*6.3 Education and Technical Assistance*

Members of the Working Groups and the Steering Committee agree that technical assistance and education is key to getting people involved in implementation. There must be a proactive approach to contact farmers, residents, and local government to articulate

exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. Educational and outreach techniques identified in the working groups will be utilized during implementation. Articles describing the TMDL process, the reasons why high levels of the pollutants are a problem, the methods through which the problem can be corrected, the assistance that is currently available for landowners to deal with the problem, and the potential ramifications of not dealing with the problem should be made available to the public through as many channels as possible, *e.g.,* agricultural and community newsletters, local papers and targeted mailings. Workshops and demonstrations should be organized to show landowners and engineering professionals the extent of the problem, the effectiveness of control measures, and technical and funding opportunities that are available. For the agricultural community, field days, pasture walks, and presentations offered through local farm groups are recommended. The emphasis should be on local farmers discussing their experiences with cost-share and volunteer BMPs, demonstrating the advantages of a clean water source and pasture management, and presenting monitoring results to demonstrate the problem. It is generally understood that farmers will be more likely to accept a new management strategy following a discussion with fellow farmers who have implemented the suggested control measures or local technical personnel rather than after presentations made by state-agency representatives.

For residential issues, public outreach should focus on increasing awareness of private residential sewage treatment systems, control of pet waste, nutrient management, and control of storm runoff (rain gardens). This outreach effort will provide useful information to residents on BMPs, funding options, and the relation of TMDL goals to overall Chesapeake Bay goals. Targeted mailings and educational materials distributed to local septic contractors were also identified as potentially successful outreach tools. Small community meetings similar to the small workshops proposed for the agricultural community can be organized for educating homeowners about residential issues. An educational packet about septic system issues should be disseminated to new homeowners. Additionally, educational tools (*e.g.,* a model septic system used to demonstrate functioning and failing septic systems, a video of septic maintenance and repair) would be useful in communicating the problem to the public.

A primary focus of urban technical assistance will be to encourage and track the efforts of citizens, local government and businesses. Educational efforts should focus on pet waste control, programs to describe the importance of E&S controls to developers, nutrient management in open urban areas, practical BMP options available and generally increasing awareness of the needs of the TMDL in urban areas. Outreach methods should include the use of media outlets, as well as direct contact with potential corporate partners and residents. Specific outreach tools identified by the Urban Working Group are discussed in section 4.

The amount of agricultural, residential, and urban full time equivalent (FTE or one full time staff member) technical assistance required was quantified based on information archived in the Virginia Agricultural BMP database and the Virginia TMDL BMP database, input from SVSWCD and input from the Steering Committee. Based on these

analyses, it was determined that approximately 2 FTEs would be needed over the course of 10 years to achieve full implementation of the agricultural control measures. It is estimated that one FTE each, for residential and urban efforts, over the ten-year Stage I and Stage II implementation periods would be adequate to provide technical assistance and manage educational outreach tasks. The total technical assistance estimated for full implementation is equivalent to 40 man-years.

The SVSWCD has preliminarily agreed to manage the agricultural and residential programs. In this capacity, they will be in charge of funds for the associated FTEs to carry out the implementation of BMPs as well as administer cost-share funds. Urban technical assistance will be provided through a cooperative approach by the local, state and federal agencies and community groups involved in the development of this plan. This approach should include cooperation on pursuing funding opportunities through grants and similar programs.

DCR staff will take the responsibility of working with SVSWCD and other partners in tracking implementation efforts as well as organizing the steering committee for evaluations of implementation progress. The steering committee also recommends that a Watershed Planning Committee be established to assist in facilitating, tracking and evaluating progress. The committee should be comprised of a broad base of stakeholder groups including municipality representatives, citizens, and community group representatives. Similar groups are successfully functioning in other areas of the Shenandoah Valley. One task that this group could pursue is the development of a comprehensive watershed plan into which this IP would be integrated. Such a plan would consider future development, conservation land-use planning and other water quality goals such as Virginia's Tributary Strategy.

*6.4 Water Quality Monitoring*

Virginia's 1997 Water Quality Monitoring, Information and Restoration Act requires that TMDL implementation plans include measurable goals and milestones for attaining water quality standards. Implicit in those milestones is the requirement of a method to measure progress. It should be noted that Virginia is in the process of switching from fecal coliform to *E. coli* as the indicator species to measure bacteria pollution. The new *E. coli* standard will apply to all sampling stations by June 30, 2008 at the latest. Implementation progress will be evaluated through fecal coliform and *E. coli* water quality monitoring conducted by VADEQ and citizen monitoring efforts through oversight by FBRG and Friends of the Shenandoah River (FOSR). VADEQ will conduct monitoring at a total of 9 stations within the Cooks Creek (6) and Blacks Run (3) watersheds (Figure 6, Table 10). Biannual biological monitoring will be conducted at the station at river mile 0.08 on Blacks Run. Monthly monitoring of water quality will be conducted indefinitely throughout implementation just downstream at river mile 0.38 Blacks Run station, while both biannual biological monitoring and indefinite monthly water quality monitoring will be conducted on the third Blacks Run station at river mile 5.62. Similarly, on Cooks Creek, both monthly water quality monitoring and biannual biological monitoring will be conducted at one monitoring station located at river mile 1.03. An additional station at river mile 3.04 will be used solely for biological

monitoring, while a station just upstream at river mile 3.10 will be monitored indefinitely for water quality on a monthly basis during implementation. Two special biological stations have been added to Cooks Creek due to requests from landowners interested in gauging the success of recently installed agricultural best management practices. The biological community at both stations (river mile 8.29 and 8.72) will be monitored in the fall of 2005 and the spring of 2006. Additionally, monthly water quality monitoring will occur at the station at river mile 8.29 through June 2006. The station at river mile 7.71 on Cooks Creek will serve as an ambient or rotating station, which will be sampled bimonthly over a six-year rotation (two years on and four years off) although the station is currently not being sampled.

FOSR currently maintains one monitoring station in each of the two watersheds. The FOSR laboratory at Shenandoah University was recently certified by the VADEQ, meaning that their volunteer monitoring data may be used in conjunction with VADEQ data to de-list the impaired reaches of Cooks Creek and Blacks Run should they begin to meet water quality standards. Currently monitoring parameters at these stations include nutrient levels, pH, temperature, ammonium and dissolved oxygen. Citizen monitors (FBRG and others) are conducting additional monitoring of coliform bacteria concentrations through a 1-year program established by VADEQ. Coliscan Easygel® is used to perform monthly monitoring of *E. coli* bacteria. The volunteers are sampling from September 2005 through June 2006. This monitoring data may be used to gauge the success of implementation in reducing the amount of bacteria in the streams; however, it cannot be used for the purpose of delisting the streams based on observed improvements. Additionally, the City of Harrisonburg and JMU monitor Blacks Run periodically. The City is currently monitoring for bacteria at 12 sites along Blacks Run in order to identify hotspots. This effort is scheduled to continue through May 2006.

Table 10: Monitoring station IDs, station locations, station types, and monitoring schedules for the Blacks Run/Cooks Creek VADEQ stations.

| Stream | Station ID | Station Location | Station Type | Frequency |
|---|---|---|---|---|
| Cooks Creek | 1BCKS001.03 | Rte. 867 bridge in Mt. Crawford | TMDL, biological | monthly, bi-annually |
| Cooks Creek | 1BCKS003.04 | Above confluence w/ Blacks Run | biological | bi-annually |
| Cooks Creek | 1BCKS003.10 | Rte. 11 bridge | TMDL | Monthly |
| Cooks Creek | 1BCKS007.71 | Rte. 701 bridge at Cooks Creek Park | Ambient | bi-monthly [1](6yr rotation) |
| Cooks Creek | 1BCKS008.29 | Off Rte. 732 at WTP | Special, biological | Monthly (Jun 06), bi-annually |
| Cooks Creek | 1BCKS008.72 | Off Rte. 732 on private property | biological | bi-annually |
| Blacks Run | 1BBLK000.08 | Just above confluence with Cooks Creek | biological | bi-annually |
| Blacks Run | 1BBLK000.38 | 600’ downstream of Rte. 704 bridge | TMDL | Monthly |
| Blacks Run | 1BBLK005.62 | End of Mosby Rd. at public works | TMDL, biological | monthly, Bi-annually |

[1] This station is sampled bi-monthly in a six year rotation, two years on and four years off. Currently this station is not being sampled.

Table 11: FSOR monitoring stations for Blacks Run and Cooks Creek.

| Stream | Station ID | Station Location | Frequency |
|---|---|---|---|
| Cooks Creek | JR07 | Upstream of confluence with Blacks Run at Rte. 11 bridge | semi-monthly |
| Blacks Run | JR08 | Rte. 704 bridge | semi-monthly |

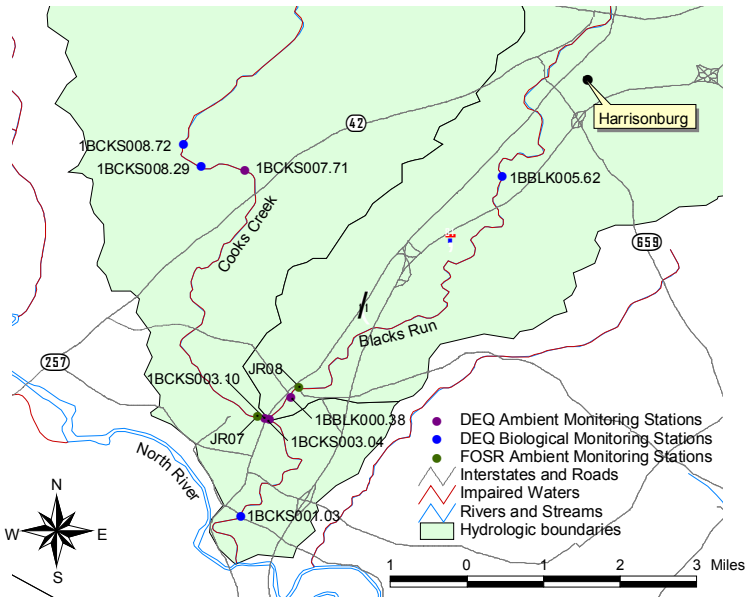


Figure 6: VADEQ and FOSR monitoring station locations.

*6.5 Implementation Costs*

Data archived in the DCR agricultural database and the DCR TMDL implementation tracking program and input from local agencies and the working groups were used to estimate average costs for agricultural and residential BMPs. Urban BMP costs are based on literature review and input from local agency representatives. It was determined in previous TMDL implementation planning efforts and through consultation with SVSWCD that it would require $50,000 to support the salary, benefits, travel, and training of one FTE. Table 12 lists the unit cost and pollutant removal cost efficiencies for all the BMPs identified as suitable for the implementation plan. The cost efficiencies identify practices that result in the greatest reduction of pollutant loads per dollar spent. A more detailed explanation of methods used to estimate costs is included in the technical report.

Stage I implementation is designed to result in significant reduction of pollutant loads with reasonable cost and effort. The total cost for Stage I implementation over a five-year period is estimated at $19.20 million with an annual cost of $3.84 million (Table 13). The cost for the five-year Stage I period breaks down to $2.41 million for agricultural BMPs, $3.62 million for residential BMPs, $12.17 million for urban BMPs, and $1 million for technical assistance. As illustrated in Tables 8 and 9, Stage I is anticipated to result in a reduction in the 1,000 cfu/100ml bacteria standard violation rate

to 19% and 18% for Cooks Creek and Blacks Run, respectively (existing violation rates are 90% and 75%). Stage I is anticipated to achieve 68% and 100% of the sediment reduction goal for Cooks Creek and Blacks Run, respectively, and 77% of the phosphorus reduction goal for Cooks Creek.

The additional expenditure for Stage II implementation needed to reach the sediment and phosphorus goals and reduce the bacteria violation rate to the greatest extent possible without wildlife reductions is anticipated to be $102.59 million (Table 14). Agricultural implementation consists of the bulk of this cost at $67.78 million. Urban implementation in Stage II adds $28.62 million to the total cost of Stage II. These elevated costs are required to treat stormwater runoff from agricultural lands and urban areas in order to reach the bacteria water quality standard. Following Stage I, the community needs to consider how to approach the Stage II goals considering available technology, current funding levels, land use patterns and community interest and priorities.

Table 12: Control measure costs and cost efficiencies (in units removed per $1,000)

| Control Measure | Units | Cost/Unit ($) | Cost Efficiencies (per $1,000) Bacteria (colonies) | Sediment (lbs) | Phosphorus (lbs) |
|---|---|---|---|---|---|
| ***Agricultural*** | | | | | |
| Grazing Land Protection Systems (SL-6) | Systems | $14,787 | 4.16E+10 | 445 | 0.284 |
| Stream Protection Systems (WP-2T) | Systems | $2,943 | 4.16E+10 | 445 | 0.284 |
| Voluntary Exclusion Systems | Feet | $2 | 1.14E+11 | 342 | 0.218 |
| Waste Storage – Poultry | Systems | $23,739 | 5.27E+10 | -- | -- |
| Waste Storage – Livestock | Systems | $66,360 | 2.87E+10 | -- | -- |
| Improved Pasture Management | Acres | $107 | 4.34E+11 | 26,516 | 16.9 |
| Conservation Tillage | Acres | $100 | 1.92E+11 | 30,972 | 18.8 |
| Retention Ponds | Ac-treated | $3,363 | 1.09E+10 | 623 | 0.276 |
| Bioretention Filters | Ac-treated | $10,000 | 3.88E+09 | 223 | 0.111 |
| Vegetated Stream Buffer | Buffer Acres | $360 | 5.58E+10 | 8,142 | 5.83 |
| Nutrient Management | Acres | $15 | -- | -- | 27.2 |
| ***Residential*** | | | | | |
| Septic System Repair | System | $3,000 | 9.69E+07 | -- | 3.83 |
| Septic System Installation | System | $6,000 | 4.40E+07 | -- | 1.73 |
| Alternative Waste Treatment System Installation | System | $15,000 | 1.76E+07 | -- | 0.693 |
| Sewer Connection | System | $5,600 | 4.71E+07 | -- | 1.86 |
| Septic Tank Pump-Outs | System | $225 | -- | -- | -- |
| Pet Litter Control Program | Program | $3,750 | 6.17E+11 | -- | -- |
| Rain Gardens | Ac-treated | $5,000 | 2.58E+08 | 103 | 0.0874 |
| Street Sweeping | Lane-miles/yr | $29 | 2.73E+09 | 1,429 | 2.10 |
| Streambank Stabilization | Feet of stream | $71 | -- | 36 | 5.99E-5 |
| Vegetated Stream Buffer | Buffer Acres | $360 | 3.56E+09 | 1,411 | 1.70 |
| ***Urban*** | | | | | |
| E&S Controls | | Existing Cost | 4.49E+07 | 1,595 | 0.862 |
| Pet Litter Control Program | Program | $3,750 | 6.17E+11 | -- | -- |
| Bioretetion Filters | Ac-treated | $10,000 | 1.29E+08 | 31.3 | 0.0399 |
| Retention Ponds | Ac-treated | $3,363 | 3.60E+08 | 87.6 | 0.0988 |
| Street Sweeping | Lane-miles/yr | $29 | 2.73E+09 | 1,429 | 2.10 |
| Streambank Stabilization | Feet of stream | $71 | -- | 14.8 | 3.66E-5 |
| Vegetated Stream Buffer | Buffer Acres | $360 | 3.54E+09 | 862 | 1.56 |
| Nutrient Management | Acres | $15 | -- | -- | 9.75 |
| ***Technical Assistance*** | | | | | |
| Full Time Equivalent (FTE) | Cost per year | $50,000 | | | |

Table 13: Costs to implement Stage I (1st 5 years) of the Blacks Run and Cooks Creek TMDLs.

| Impairment | Agricultural BMPs (Million $) | Residential BMPs (Million $) | Urban BMPs (Million $) | Technical Assistance (Million $) | Total (Million $) | Total Cost Per Year (Million $) |
|---|---|---|---|---|---|---|
| **Cooks Creek** | 2.27 | 3.44 | 5.51 | - | 11.22 | 2.24 |
| **Blacks Run** | 0.16 | 0.18 | 6.66 | - | 7.00 | 1.40 |
| **Total** | **2.41** | **3.62** | **12.17** | **1.00** | **19.20** | **3.84** |

Table 14: Costs to implement Stage II (2nd 5 years) of the Blacks Run and Cooks Creek TMDLs.

| Impairment | Agricultural BMPs (Million $) | Residential BMPs (Million $) | Urban BMPs (Million $) | Technical Assistance (Million $) | Total (Million $) | Total Cost Per Year (Million $) |
|---|---|---|---|---|---|---|
| **Cooks Creek** | 61.06 | 4.57 | 3.68 | - | 69.31 | 13.86 |
| **Blacks Run** | 6.72 | 0.62 | 24.94 | - | 32.28 | 6.46 |
| **Total** | **67.78** | **5.19** | **28.62** | **1.00** | **102.59** | **20.52** |

*6.6 Implementation Benefits*

*Clean Water*: The primary benefit of implementation is cleaner waters in Virginia. Specifically, fecal contamination, and sediment and phosphorus concentrations in Blacks Run and Cooks Creek will be reduced to maintain high quality water for downstream uses. It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from fecal sources through contact with surface waters should be reduced considerably. Additionally, because of stream-bank protection that will be provided through exclusion of livestock from streams, restoration of the riparian areas, streambank stabilization and the suite of BMPs discussed in this document, the aquatic habitat will be improved in these waters. The vegetated buffers that are established will also serve to reduce sediment and nutrient transport to the stream from upslope locations. In areas where pasture management is improved through implementation of grazing land protection BMPs, soil and nutrient losses should be reduced. Additionally infiltration of precipitation should be increased, decreasing peak flows downstream. These water quality benefits are particularly important in light of increasing concerns in the Shenandoah Valley and the entire Chesapeake Bay watershed.

*Economics*: An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the landowner, as well as, the expected environmental benefits onsite and downstream. Specifically, alternative (clean) water sources, exclusion

of cattle from streams, improved pasture management, and private sewage system maintenance or upgrades will each provide economic benefits to individuals.

Taking the opportunity to implement an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase livestock stocking rates by 30 - 40%, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70-80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of .01-.02 cents/lb of total digestible nutrients (TDN) compared to .04-.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VACES, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits, by allowing higher stocking rates and increasing the amount of gain per acre. A side benefit is that cattle are more closely confined allowing for quicker checking and handling.

In terms of economic benefits to homeowners, an improved understanding of private sewage systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20-25 years or longer if properly maintained. Proper maintenance includes; knowing the location of the system components and protecting them by not driving or parking on top of them, and not planting trees where roots could damage the system, keeping hazardous chemicals (including water softening chemicals) out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, improvements to private waste treatment systems can enhance property values.

The economic benefits of the implementation of urban BMPs may be less obvious to an individual landowner or business, but the cumulative impacts can benefit the entire community. It is estimated that excessive erosion and sediment transport in waterways of the United States results in a $16 billion economic impact each year (Osterkamp et al., 1998). Harrisonburg and Rockingham County have inevitably been economically affected by the impairments on Blacks Run and Cooks Creek. In areas like Harrisonburg and Rockingham County, a healthy waterway has the potential to attract local citizens and visitors for recreation as well as draw people to commercial areas adjacent to attractive, healthy streams.

*Livestock Health Improvements:* A clean water source has been shown to improve weight gain and milk production in cattle. Healthy cattle consume close to 10% of their body weight during winter and 15% of their body weight in summer in water on a daily basis. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with

manure (VACES, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VACES, 1998). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing and well managed loafing areas exclude livestock from wet, swampy environments often found next to streams where cattle have regular access. Keeping cattle in clean dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VACES (1998) reports that mastitis currently costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7-2 billion annually or 11% of total U.S. milk production. Mastitis-causing bacteria can be harbored and spread in environments where cattle have access to wet and dirty areas.

*Reduce Exposure to Human Pathogens:* The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry with it.

## 7. Stakeholder's Roles and Responsibilities

Stakeholders include government agencies, businesses, citizens and special interest groups that live or have land management responsibilities in the watershed. Achieving the goals of this effort (i.e., improving water quality and removing these waters from the impaired waters list) relies on stakeholder participation. The purpose of this section is to identify and define the roles of some of the major stakeholders who will need to work together to implement this plan.

### *7.1 Federal Government*

United States Environmental Protection Agency (USEPA): The USEPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act (CWA). However, administration and enforcement of such programs falls largely to the states.

Natural Resources Conservation Service (NRCS): NRCS administers several funding programs identified in this plan including the Environmental Quality Incentives Program (EQIP) and the Conservation Reserve Enhancement Program (CREP). Locally, NRCS works closely with the SVSWCD to provide technical assistance to producers interested in conservation programs.

### *7.2 State Government*

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. State government has the authority to establish state laws that control delivery of pollutants to local waters. An example of this authority is a recent addition to the Virginia Code that allows localities to prohibit feeding of waterfowl that are found to exist in populations that threaten public health or the environment (§ 29.1-527.1). Another example is 2005 legislation (§ 10.1-

104.1) that requires state lands, including universities (e.g., JMU) that apply fertilizer to develop and implement a nutrient management plan. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies include: Virginia Department of Environmental Quality, Virginia Department of Conservation and Recreation, Virginia Department of Agriculture and Consumer Services, and Virginia Department of Health.

VADEQ: VADEQ has responsibility for monitoring the waters to determine compliance with state standards, and for requiring permitted, point source dischargers to maintain loads within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. In addition, DEQ has regulatory responsibility over animal waste from confined animal facilities in excess of 300 animal units of cattle and hogs and 200 animal units of poultry through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent groundwater contamination (ELI, 1999). DEQ will maintain the monitoring stations described in this plan. In addition, DEQ's Valley Regional Office has submitted a Virginia Water Quality Improvement Fund (WQIF) proposal with the SVSWCD to promote "Common Sense Solutions to Water Pollution" to watershed residents and businesses. This proposal directly addresses TMDL implementation goals.

VADCR: VADCR holds the responsibility for addressing nonpoint sources (NPS) of pollution including nutrient management, erosion and sediment control, stormwater, and agricultural BMPs. Most VADCR programs dealing with agricultural NPS pollution historically have been through education and voluntary incentive programs. In terms of the implementation of this plan, VADCR will coordinate agricultural and residential implementation through SVSWCD and work with local stakeholders to track urban implementation efforts. VADCR also has regulatory authority over Virginia's National Pollution Discharge Elimination System (NPDES) permits for Municipal Separate Storm Sewer Systems (MS4). These permits require MS4 operators to develop, implement and enforce six minimum control measures to reduce pollutants entering surface waters through stormwater runoff. Current VADCR MS4 guidance expects the permittee in areas under a TMDL to specifically address the TMDL wasteload allocations for stormwater through the implementation of programmatic BMPs. BMP effectiveness will be determined through in-stream monitoring. If future monitoring indicates no improvement in stream water quality, the permit could require the MS4 to better tailor its stormwater management program to achieve the TMDL wasteload allocation. However, only failing to implement the programmatic BMPs identified in the modified stormwater management program would be considered a violation of the permit. Currently, the City of Harrisonburg and VDOT hold Phase II MS4 permits. James Madison University is currently in the process of obtaining an MS4 permit (Figure 7).

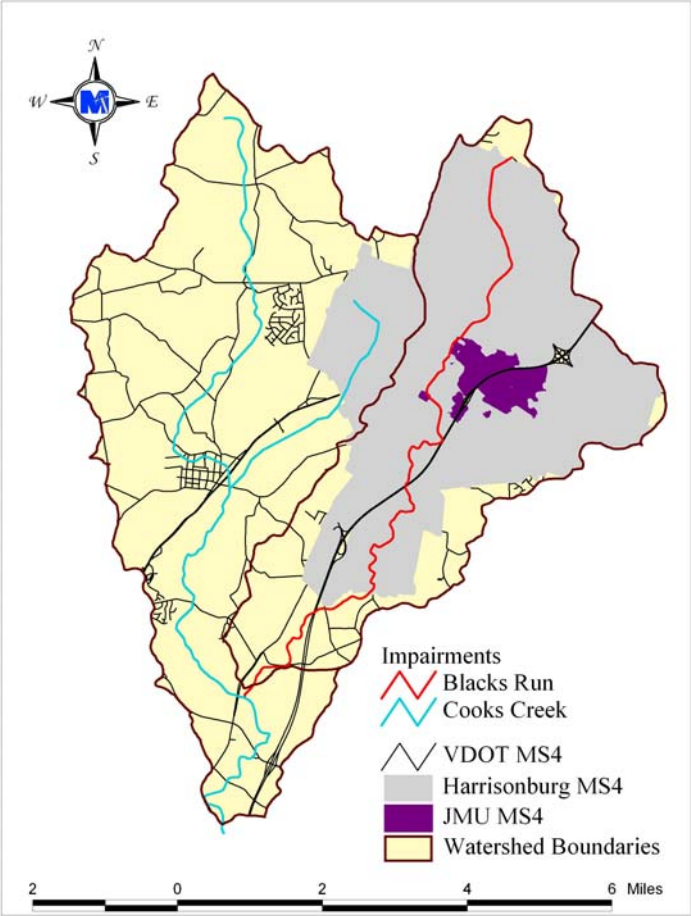


Figure 7: Location of existing and potential MS4 permits.

Virginia Department of Agriculture and Consumer Services (VDACS): Through Virginia's Agricultural Stewardship Act, VDACS and the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. It is not the intention of this plan to actively use the Agricultural Stewardship Act to force producers into conservation measures.

Virginia Department of Health (VDH): VDH is responsible for maintaining safe drinking water measured by standards set by the USEPA. Their duties also include septic system regulation and regulation of biosolids land application according to the *Virginia Sewage Handling and Disposal Regulations*. Like VDACS, VDH is complaint driven. In the scheme of these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes. In the implementation project, the

VDH will write permits for new septic systems and refer customers needing assistance to SVSWCD.

Virginia Cooperative Extension (VCE): VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University). VCE offers educational programs and technical resources for topics including agricultural and residential conservation practices.

*7.3 Local Government*

Shenandoah Valley Soil & Water Conservation District (SVSWCD): The SVSWCD will provide technical and financial assistance to farmers and homeowners through the Virginia Agricultural BMP Cost-Share and Tax Credit programs. Their responsibilities will include promoting implementation goals, available funding and the benefits of BMPs and providing assistance in the survey, design, layout, and approval of agricultural and residential BMPs. The SVSWCD has filled this role in the North River TMDL Implementation Project since 2001. As mentioned above, the SVSWCD has also collaborated with the DEQ Valley Regional Office on a Virginia WQIF proposal which addresses TMDL implementation issues.

City of Harrisonburg: Harrisonburg is contained within the Cooks Creek and Blacks Run watershed and comprises approximately 40% of the total watershed area. The City maintains a number of programs that address water quality through the Public Works, Community Development, Public Utilities and Parks and Recreation Departments that are discussed in section 7.5. Most notably, the Public Works Department administers the City's MS4 permit that addresses a series of water quality issues. The City of Harrisonburg has several ordinances relating to maintaining or improving water quality including an ordinance prohibiting pet waste from being left on public or private lands (Code Section 15-2-4) and the ordinance prohibiting illicit discharge or cross connections into city sewer (Code Section 7-3-81). Additionally, Harrisonburg City Council recently approved an ordinance allowing the Police Department to thin the deer herd. The first population reduction of approximately 19 deer is planned for early 2006. The City has been involved throughout the development of this plan and has submitted a proposal through the Virginia WQIF to enhance its street sweeping and pet waste programs in order to contribute to the implementation goals.

Rockingham County: Rockingham County comprises approximately 60% of the watershed area addressed in this plan. The majority of this is agricultural areas, with pockets of urban areas adjacent to Harrisonburg and in the Town of Dayton. County staff from the Community Development and Public Works Departments were involved in the urban and government working groups. The County maintains an erosion & sediment control program and is planning a stormwater program as discussed in section 7.5.

*7.4 Community Organizations and Citizens*

Friends of the Blacks Run Greenway (FBRG): FBRG is a public-private organization whose restoring the stream channel and banks of Blacks Run and it tributaries to a healthy condition. FBRG projects related to the goals of this plan include an annual clean-up day, community outreach activities and several streambank restoration projects

including a significant restoration of Blacks Run and Seiberts Creek in Purcell Park. These projects are discussed further in section 7.5. FBRG contributed throughout the development of this plan.

Canaan Valley Institute (CVI): CVI is a nonprofit organization committed helping communities in the Mid-Atlantic Highlands address problems that threaten the environmental, economic, and cultural resources of their watersheds. CVI has worked with FBRG on its greenway projects in the past and currently is collaborating with FBRG and the City of Harrisonburg on the stream restoration project in Purcell Park.

Rockingham Farm Bureau: Representatives from the Rockingham Farm Bureau participated in the agricultural working group and the steering committee. Their input and participation will continue to be critical to engage the local agricultural community in conservation programs.

*7.5 Current and Planned Local Implementation Activities*

Through MS4 permits, existing regulatory controls, and existing programs and projects, the local community as a whole, local municipalities and community groups are currently maintaining practices that address bacteria, sediment and phosphorus. This section describes some of the existing MS4 permit activities and other existing and planned implementation actions that are pertinent to this implementation plan.

1) Sewer Rehabilitation

The Harrisonburg Public Utilities Department maintains approximately 170 miles of sewer lines. The Department has an inflow and infiltration (I&I) abatement program and a general program to rehabilitate aging infrastructure. These rehabilitation efforts consist of 3 main programs: (1) improving the Blacks Run interceptor, (2) addressing areas of infiltration and inflow (I&I), and (3) rehabilitation of known sewer problems. The Public Utilities Department recently completed a three-year contract for sanitary sewer rehabilitation and has begun a new contract. Public Utilities and the urban working group discussed the possibility of focusing some of the future I&I abatement and maintenance efforts in the areas immediately adjacent to Blacks Run and the Blacks Run Interceptor. The City's sewage collection system delivers wastewater to Harrisonburg-Rockingham Regional Service Authority (HRRSA) interceptors. HRRSA monitors flow and has a routine inspection and repair program. The Town of Dayton maintains its sewer system and has an on-going sewer maintenance program. The town schedules replacement and repair of sewer lines and manholes on a bi-annual basis. New lines have recently been installed in coordination with upgrades to the water treatment plant. Additionally, the town periodically sends cameras through the lines to find problem areas.

2) Inspection and General Maintenance of Storm Sewer Systems

The City of Harrisonburg has mapped and identified all of the outfalls into Blacks Run, with the exception of the southernmost 1.5 miles using Global Positioning System (GPS) technology. Pipes with any obvious effluent problems were removed, including water and sewer pipes that were damaged or leaking. In the summer of

2005, city personnel visited all of the mapped outfalls to inspect and determine if any illicit discharges exist. Resources are being expended towards developing facilities to test the effluent from outfalls to detect non-stormwater material. Storm drains are also inspected and cleaned to remove any possible obstructions. The City has initiated a storm drain geographical information system (GIS) mapping system. Updates are made based on site plans submitted by developers. The project is being extended to include storm drains on private streets, parking lots, and detention ponds. The City also dedicates a portion of its stormwater management web site to the reporting of pollution events by citizens.

The City regularly works with local businesses and citizens to address individual water quality issues. The City maintains pet waste stations at four city parks that include signage, disposal bags and a disposal receptacle. The WQIF proposal mentioned above includes adding an additional 10 stations distributed in the City's 7 parks and two other public locations. The Parks and Recreation Department is also working to establish "no-mow zones" along waterways in parks. The City maintains a street sweeping program to reduce the pollutant load in stormwater. In 2003, 4,090 lane miles were swept resulting in 1,601 cubic yards of debris. The WQIF proposal also includes the purchase of a new street sweeper, which would more than double sediment removal rates. Additionally, drop inlet trapping devices are being investigated for possible use in conjunction with a plan to establish a "Streetscape" in downtown Harrisonburg.

VDOT is currently developing a protocol and prioritization for inspections of illicit discharges. The protocol will become an element of all routine, emergency, and requested maintenance activities on VDOT's drainage systems. Training on illicit discharge inspection will be developed in coordination with VDOT's hazardous materials spill response protocol. Following the development of the protocol and training, implementation will begin to inspect, detect and address non-stormwater discharges in 100% of regulated outfalls within the area addressed by VDOT's MS4 permit (I-81 corridor). VDOT has compiled an existing storm sewer map resource and included the local jurisdictional information as well.

3) Public Outreach

In order to inform the public regarding the City's stormwater management program and general water quality issues, Harrisonburg has produced multiple brochures and other forms of literature. The publications include a brochure on Blacks Run water quality and a brochure explaining rain gardens that was developed in coordination with the installation of a rain garden in Westover Park. The City of Harrisonburg stormwater management program website was made accessible to the public on March 1, 2004. The website provides information on the economic benefits of stormwater management and local programs and events related to stormwater management.

The City has been involved in several educational activities in the local school systems and through partnership with the local colleges. The City provides funded intern positions to assist with stormwater-related activities. The City also partners

with FBRG on the Annual Blacks Run/Downtown Cleanup Day. The City, along with FBRG and Canaan Valley Institute, is currently working on a streambank revitalization in Purcell Park. During the construction phase of the streambank restoration project in Purcell Park, signage will be placed throughout the park explaining erosion and the impact of runoff on streambanks. The City also installed signs in January 2006 adjacent to streams in City parks explaining that Blacks Run is impaired for bacteria and may pose a health risk.

VDOT is currently developing an educational video on stormwater impacts and stormwater BMPs that will be distributed to local governments and citizens. A series of public service announcements related to stormwater issues are also planned. VDOT participates in regional stormwater planning and implementation meetings. They also participate in local government technical advisory groups and workshops to develop watershed plans including this implementation plan. VDOT also maintains an ongoing Adopt-A-Highway program that partners with community organizations and businesses to remove trash and debris from VDOT right-of-ways. Additionally, as part of their MS4 permit, VDOT is developing and installing signs identifying watersheds along VDOT right-of-ways.

4) Streambank Restoration and Post-Construction Stormwater BMPs

The City, along with Friends of the Blacks Run Greenway and Canaan Valley Institute, is currently working on a streambank revitalization project to prevent future erosion in Purcell Park. The project involves restoring 3,000 feet of Blacks Run and Sieberts Creek (a tributary). The dimensions of the streams will be changed and structures will be constructed in the stream to slow down stream velocity and reduce streambank erosion. A vegetated riparian buffer with a minimum depth of 10 feet on each side of the streams will be maintained to further protect the streambanks during times of high stream flow. The preliminary design is complete and work is currently underway to secure funds to implement the project. The City has committed funds to the project. Other areas of stream restoration activities include a section of Blacks Run adjacent to Liberty Park in downtown Harrisonburg, a section of Blacks Run near the Farm Bureau building on Maryland Avenue and a private site on Blacks Run. In addition, the City has recent hyperspectral imagery that it hopes to use to identify existing buffered areas and areas of potential buffer establishment. The City is currently working with JMU and Canaan Valley Institute to develop a plan of work with students to identify potential buffer restoration sites.

The City intends to adopt the Virginia stormwater management regulations and prepare an ordinance around the State's model, which is currently under development. Rockingham County is also planning on developing stormwater management regulations when the VADCR model ordinance is available. During the development of this IP, a survey of stormwater retrofit projects in the Blacks Run and Cooks Creek watersheds was completed. The following sites of retrofit rain garden or bioretention filter practices were identified and taken into account in the development of this IP; 1) Virginia Mennonite Retirement Community, 2) Mountain View Elementary, 3) Thomas Harrison Middle School, 4) Westover Park, 5) Liberty

Park, 6) DEQ Regional Office, 7) JMU CISAT parking, 8) JMU adjacent to Newman Lake and 9) JMU, parking lot at South Main and Bluestone Drive.

5) Erosion and Sediment Control
The City maintains an erosion and sediment (E&S) control program that is regulated by VADCR. VADCR has recommended that the City bring its ordinance up-to-date with current Virginia standards and strengthen enforcement regulations. The City has been evaluating options for enforcement that will reduce time, but also increase effectiveness. Model ordinances have been reviewed and research is being done to find other jurisdictions in Virginia that have stricter, though easier to administer, enforcement regulations. The desired goal is the ability to invoke civil penalties without going to court. This will be pursued along with the stormwater ordinance. The urban working group identified expanding the City E&S staff as critical to ensuring that E&S laws are followed.

Rockingham County also maintains an E&S program under the state program administered by VADCR. Currently, the county has one inspector for E&S issues for the entire county. The urban working group recommended that additional county inspection staff would result in improved compliance with E&S laws.

VDOT has comprehensive erosion and sediment control and stormwater management programs, which have been approved by VADCR. VDOT has also developed an environmental compliance reporting system and continually evaluates new products for erosion and sediment controls. VDOT developed an erosion and sediment control certification program in 2003. Certification is required for individuals conducting land-disturbing activities on VDOT owned or operated property.

## 8. Integration with Other Watershed Plans

Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy: The Virginia Tributary Strategy, released in March 2005, outlines an approach for meeting ambitious reductions in nitrogen, phosphorus and sediment. The document for the Shenandoah/Potomac Basin identifies types and estimated quantities of specific BMPs that are needed to meet water quality goals in the Bay. The strategy calls for implementation of conservation BMPs on 92% of agricultural lands, enhancement of Virginia's stormwater management and erosion and sediment control programs and nutrient management on approximately 90%, 78% and 99% of agricultural, mixed open and urban lands, respectively. The quantity estimates listed in the strategy are based on a large watershed scale and are not specific enough to translate directly to addressing the impairments in watersheds the size of Blacks Run and Cooks Creek. However, the following BMPs identified in the tributary strategy are also identified as critical to meeting the specific water quality goals for Blacks Run and Cooks Creek:

- Stream exclusion fencing
- Conservation tillage
- Nutrient management
- Erosion & sediment control
- Stream restoration
- Filtering storm water practices
- Septic system improvements
- Grazing land protection

Implementation of the practices outlined in this plan will contribute to the implementation of the Shenandoah/Potomac Tributary Strategy.

## 9. Funding Sources

As mentioned, some of the control measures outlined in this plan will be implemented as part of existing programs including the MS4 permits. Potential funding sources available for remaining implementation activities were identified during plan development. More detailed descriptions of each source are included in the technical document and can also be obtained from the SVSWCD, VADCR, NRCS, VACES, and VADEQ. Potential funding sources include:

- *EPA 319 Grant Incremental Funds:* Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement nonpoint source programs. VADCR administers the money to fund watershed projects, demonstration and educational programs, nonpoint source pollution control program development, and technical and program staff including TMDL Implementation. During implementation in the Blacks Run and Cooks Creek watersheds, standards, specifications, cost-share, and tax credits for practices under the Virginia Agricultural BMP Cost-share Program will be followed for funding eligibility. This project has been placed on the plan of work for DCR's 2005 319 grant. Section 319 funds should be available at the completion of the IP, and in subsequent years during implementation, given reasonable progress toward implementation goals.
- *Virginia Agricultural Best Management Practices Cost-Share and Tax Credit Programs:* The cost-share program is funded with state and federal moneys through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into our waters. Cost-share is typically 75% of the actual cost, not to exceed $50,000. Each practice under the cost-share program has specifications and a lifetime during which the practice must be maintained. For all taxable years, a farmer can also take a 25% state tax credit on the first $70,000 spent on agricultural BMPs. Information is available at www.dcr.virginia.gov/sw/costshar.htm.
- *Virginia Water Quality Improvement Fund:* This is a permanent fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint source pollutant loads to Virginia's waters. A primary objective of this fund is to reduce the flow of excess sediment, nitrogen and phosphorus into the Chesapeake Bay. Eligible organizations include local governments, SWCDs, universities and individuals. Grants for point sources are administered through VADEQ and grants for nonpoint sources are administered through VADCR. Most WQIF grants provide matching funds on a 50/50 cost-share basis. A request for proposals is distributed annually. Information is available at www.dcr.virginia.gov/sw/wqia.htm.
- *Conservation Reserve Enhancement Program (CREP):* CREP is a cost-share program administered by NRCS that assists farmers to protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. The program offers cost-share, rental payments and an incentive payment to protect riparian areas including exclusion fencing, alternative watering systems and riparian easements. Information is available at www.dcr.virginia.gov/sw/crep.htm.

- *Environmental Quality Incentives Program (EQIP*): EQIP is a federal cost-share program administered by NRCS that provides 35%-75% cost-share and incentive payments for agricultural conservation measures. Virginia's priority considerations for EQIP projects are: grazing land, cropland concerns, animal waste and forest concerns. Information is available at http://www.va.nrcs.usda.gov/programs/eqippage.html.
- *National Fish and Wildlife Foundation (NFWF) grants:* NFWF funds projects to conserve and restore fish, wildlife, and native plants through matching grant programs. The Foundation awards matching grants to projects that address priority actions promoting fish and wildlife conservation and the habitats on which they depend, work proactively to involve other conservation and community interests, leverage Foundation-provided funding, and evaluate project outcomes. NFWF administers a general grant program along with a range of special grant programs. Information is available at www.nfwf.org.
- *Southeast Rural Community Assistance Project (Southeast RCAP):* The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. The project provides grants to low-income families (below 125% of the federal poverty level) for new wastewater facilities and sewer hook-up costs. Information is available at www.southeastrcap.org.
- *Chesapeake Bay Small Watershed Grants Program:* The Chesapeake Bay Small Watershed Grants Program provides grants to organizations working on a local level to protect and improve watersheds in the Chesapeake Bay basin, while building citizen-based resource stewardship. The program is a partnership between the EPA and NFWF. Information is available at www.nfwf.org/programs/chesapeake.
- *Community Development Block Grant Program:* The Virginia Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Specific activities may include provision of public facilities and improvement, such as new or improved water and sewer facilities. Rockingham County and the City of Harrisonburg are eligible communities. Information is available at www.dhcd.virginia.gov/CD/CDBG/.
- *Virginia Aquatic Resources Trust Fund:* The Army Corps of Engineers and the Nature Conservancy cooperatively administer the Virginia Aquatic Resources Trust Fund. The Fund uses money provided by development impacting wetlands and streams to implement projects involving the restoration or protection of wetlands or streams to compensate. Information is available at http//:nature.org.

**List of Acronyms**

| | |
|---|---|
| BMP | Best Management Practice |
| CLU | Common Land Unit |
| CREP | Conservation Reserve Enhancement Program |
| CWA | Clean Water Act |
| EPA | Environmental Protection Agency |
| EQIP | Environmental Quality Incentive Program |
| FBRG | Friends of Blacks Run Greenway |
| FC | Fecal Coliform |
| FOSR | Friends of Shenandoah River |
| FTE | Full Time Equivalent |
| GWLF | Generalized Watershed Loading Function |
| HRRSA | Harrisonburg-Rockingham Regional Service Authority |
| HSPF | Hydrological Simulation Program-Fortan |
| IP | Implementation Plan |
| JMU | James Madison University |
| MS4 | Municipal Separate Storm Sewer System |
| NPDES | National Pollution Discharge Elimination System |
| NPS | Nonpoint Source Pollution |
| NRCS | Natural Resources Conservation Service |
| RB-1 | Septic tank pump out |
| RB-2 | Septic connection to public sewer system |
| RB-3 | Septic system repair |
| RB-4 | Septic system installation/replacement |
| RB-5 | Alternative waste treatment system |
| SL-6 | Grazing Land Protection System |
| SVSWCD | Shenandoah Soil and Water Conservation District |
| TMDL | Total Maximum Daily Load |
| VADCR | Virginia Department of Conservation and Recreation |
| VADEQ | Virginia Department of Environmental Quality |
| VCE | Virginia Cooperative Extension |
| VDACS | Virginia Department of Agriculture and Consumer Services |
| VDH | Virginia Department of Health |
| VDOT | Virginia Department of Transportation |
| WP-2T | Stream Protection System |
| WQMIRA | Water Quality Monitoring, Information and Restoration Act |

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Appendix A: Best Management Practices Selected for the Blacks Run and Cooks Creek Water Quality Implementation Plan

| Control Measure | Description | Target Locations |
|---|---|---|
| Streamside fencing | Installation of fencing adjacent to streams in order to exclude livestock along with vegetated buffers and other structures necessary to reduce pollutant delivery to streams. The state cost-share practices associated with streamside fencing on pasturelands are SL-6, WP-2T and WP-4B described in the *Virginia Agricultural BMP Manual*. In addition, it is anticipated that a large amount of the fencing needed will be installed voluntarily. | Pasture Areas, loafing lots and cropland that provide livestock access to streams. Four SL-6 systems currently exist in the Cooks Creek watershed along with approximately 9,000 of voluntary exclusion fencing. The majority of fencing needs are in the Cooks Creek watershed with a small amount in the lower portion of the Blacks Run watershed. |
| Corrected straight pipe | A straight pipe is a discharge of household waste to a stream or drainage without a proper treatment method. The state cost-share program offers 2 practices, RB-4 and RB-5, which can be used to replace a straight pipe with a functioning treatment system. | Concentrations of older homes/ businesses in close proximity to streams. Based on analysis of census data, public sewer locations and VDH input, rural areas in Cooks Creek have the highest potential for straight pipes. Specific areas were identified and will be provided to SVSWCD. |
| Repair/replacement of failing septic system | A failing or malfunctioning septic systems has the potential to deliver waste to the surface, which can then be delivered to a stream by gravity or runoff. The state cost-share program offers 3 practices, RB-3, RB-4 and RB-5, which can be used to repair a septic system or replace it with a functioning alternative waste treatment system. | Concentrations of older homes/ businesses in close proximity to streams. Rural areas in upstream Cooks Creek watershed and downstream Blacks Run have the highest potential for straight pipes. Estimates of failing septic systems by subwatershed that were determined during IP development will be provided to SVSWCD for targeting. |
| Pet Litter Control Program | A combination of educational materials distributed to pet owners along with signage describing water quality concerns related to pet waste, disposal bags and receptacles in areas of high pet traffic. | Educational materials such as brochures would be distributed to citizens in residential and urban areas throughout the watersheds. Pet waste signage, disposal bags and receptacles would be focused in City and County Parks along with other high traffic areas. Harrisonburg's pet waste program and proposed enhancements are described in section 7.5. Locations identified in the Cooks Creek watershed include Phibbs and Cooks Creek Parks in Dayton |
| Manure/ Poultry litter storage | The storage and proper handling of livestock and poultry waste in adequate facilities in order to reduce the amount available for runoff and facilitate die-off of bacteria. Storage facilities include dry stacking, aerobic and anaerobic lagoons, liquid manure tanks, and settling basins. The state cost-share program offers an animal waste control facility practice (WP-4). | Based on information from the SVSWCD, there are currently about 67 waste storage systems in the Cooks Creek watershed. Future needs for waste control facilities associated with dairies and poultry operations are anticipated to concentrated in the Cooks Creek watershed, both upstream and downstream of Dayton. |
| Street Sweeping | Street sweeping reduces the load of sediment and associated nutrients that is available for runoff from streets, into storm water systems and drainages and ultimately into stream. | Harrisonburg currently has one street sweeper that operates throughout the city on specified routes. The City is currently looking into obtaining an additional sweeper (Regenerative Air Street Sweeper) to focus on critical areas. Potential areas of street sweeping in the Cooks Creek watershed include Dayton and developing residential and commercial areas adjacent the western boundary of Harrisonburg. |
| Streambank Restoration | Streambank restoration can take many forms, however a natural stream channel design approach is favored. This method reduces channel and bank erosion through establishment of suitable vegetation, returning the | Streambank restoration is appropriate for sections of degraded streams in urban, residential, and agricultural areas. Harrisonburg has completed 3 restoration projects along Blacks Run and is currently in the planning stages |

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| | channel to a "natural" geomorphic condition (pools and riffles), and in-stream structures to slow and deflect flow. | of a project to restore approximately 3,000 ft of Blacks Run and Sieberts Creek. These projects are further discussed in section 7.5. Work is currently underway using remote sensing imagery to identify areas in the Blacks Run watershed that would be suitable for restoration efforts. |
| Nutrient Management | The development and implementation of a nutrient management plan limits the delivery of nutrients to streams related to agricultural, residential and commercial fertilization. The state cost-share specification for nutrient management plans is NM-1. Nutrient management regulations changes significantly in January 2006, in order to focus on phosphorus based plans. | Historically, nutrient management in this area has focused on agricultural production. There has recently been increased effort to establish nutrient management techniques in areas of residential, public and commercial landscaping. In addition, JMU will be required to adhere to a nutrient management plan by July 2006. Implementation will include promotion of nutrient management in residential and urban areas of the watersheds. |
| Vegetated Buffers | Establishing vegetated buffers along streams provides a filter of sediment, nutrients and bacteria, reduces streambank erosion, controls water temperature, provides aquatic habitat and establishes a measure of natural flood control. Several state and federal programs provide assistance for buffer establishment in agricultural areas including the NRCS CREP program and Virginia cost-share practice (FR-3). | Establishing vegetated buffers in agricultural, residential and urban areas of these watersheds would serve to reduce all of the pollutants addressed in this plan. The widths of buffer will vary depending on the availability of land. A vegetated buffer is an integral component of stream exclusion and streambank restoration practices. |
| Improved pasture management | The establishment of a rotational grazing system along with nutrient management of pastureland. This practice protects vegetation to reduce runoff. The state grazing land protection cost-share practice (SL-6) provides financial assistance for some of these functions. | There are currently four cost-share practices establishing grazing land protection systems in the Cooks Creek watershed. Future needs are anticipated to be concentrated in the Cooks Creek watershed, both upstream and downstream of Dayton. |
| Conservation Tillage | The planting of crops with minimal disturbance of the soil. The practice also entails maintaining cover crops or crop residue on a certain portion of a field (typically >30%). In Virginia, the continuous no-till practice (SL-15A) requires a minimum of 80% residue cover. | The vast majority of cropland in these watersheds (~90%) is located in the Cooks Creek watershed. Based on discussions with SVSWCD and local farmers, conservation tillage is used in some cases in the watershed but that the potential for expansion exists. |
| Erosion & Sediment Controls | Harrisonburg and Rockingham County maintain E&S programs for disturbed land in accordance with the Virginia erosion & sediment control laws and regulations. | E&S controls are focused on areas of soil disturbance associated with a variety of construction activities. E&S controls are required for the development that is occurring throughout both of these watersheds. |
| Bioretention filters/ rain gardens | These practices consist of a depressed area planted with woody and herbaceous plants. The planted bed is underlain by filtering soil. The vegetation and filter material serves to treat storm water by filtering out sediment, bacteria, nutrients and other pollutants. A typical bioretention filter is 25 feet by 50 feet and treats 1-2 impervious acres. In karst areas an underdrain will deliver filtered storm water to the storm system or drainage system. These practices correspond to practice 3.11A in the Virginia Stormwater Management Handbook. | Bioretention filters and rain gardens are suited for treatment of stormwater in residential and urban areas. These practices are a preferable option because they can typically be incorporated into existing landscaping, are relatively inexpensive for the treatment capacity and require minimal maintenance if properly installed. An inventory of existing bioretention filters identified nine existing practices in these watersheds. |

*Not all of the BMPs listed in this table are available for government cost-share programs. Specifications for cost-share program eligibility can be obtained from VADCR and the Shenandoah Soil & Water Conservation District.

# Local Contact Information

Shenandoah Valley Soil & Water Conservation District/ Natural Resources Conservation Service
1934 Deyerle Avenue, Suite B
Harrisonburg, Virginia 22801
(540) 433-2853

Harrisonburg Stream Health Coordinator
(540) 437-1258

Friends of Blacks Run Greenway
(540) 437-0050

Virginia Department of Conservation & Recreation
44 Sanger Lane, Suite 102
Staunton, Virginia 24401
(540) 332-9238

Virginia Department of Environmental Quality
4411 Early Road
P.O. Box 3000
Harrisonburg, Virginia 22801
(540) 574-7800

Central Shenandoah Health District
Rockingham-Harrisonburg Office
110 North Mason Street
Harrisonburg, Virginia 22801
(540) 574-5200

Virginia Cooperative Extension
965 Pleasant Valley Road
Harrisonburg, Virginia 22801
(540) 564-3080